INSTRUCTION MANUAL

SUBCARRIER DISCRIMINATOR
MODEL GFD-5

DCS DATA-CONTROL SYSTEMS, INC., EAST LIBERTY STREET, DANBURY, CONNECTICUT

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COMPOSITION PAGE

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Figure 1-1. Subcarrier Discriminator, Model GFD-5B

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. PURPOSE AND SCOPE.

1-2. This publication contains a general description with installation, operating and maintenance instructions for the Subcarrier Discriminator, Model GFD-5, designed and manufactured by Data Control Systems, Inc., East Liberty Street, Danbury, Connecticut.

1-3. A general discussion of the electrical and physical characteristics of the equipment is covered in Section I. An overall functional description using a block diagram and a detailed functional description referencing simplified schematic diagrams, completes this section. Installation (II) and Operation (III) are presented in a manner which should be of practical value to personnel not familiar with initial setup and operation of the equipment. Maintenance (IV) includes a list of required test equipment, preventive maintenance to be performed periodically, minimum performance tests and a troubleshooting procedure. Section V is made up of printed circuit board drawings with the tabular data necessary for the identification, location and requisition of parts.

1-4. Material requiring clarification is illustrated with line drawings, halftones or listed in tabular form.

1-5. INTRODUCTION TO THE EQUIPMENT.

1-6. Subcarrier Discriminator, Model GFD-5 (see Figure 1-1) is an FM demodulator utilized in radio telemetering installations for detection of analog voltages transmitted from remote and inaccessible locations. It is particularly adaptable to multiplexed systems where banks of discriminators must be used for direct acquisition of subcarrier data or magnetic tape playback of the composite signal. This module fulfills a technological requirement present in modern data systems, demanding that reliable equipment be developed in a package small enough to eliminate space-confining problems. Moreover, its inherent good design permits reliable performance where power consumption is a critical factor.

1-7. SUBCARRIER DISCRIMINATOR, MODEL GFD-5.

1-8. Model GFD-5 is a transistorized, pulse averaging discriminator designed for use in DCS UNIDAP data system. Interchangeable, plug-in tuning units and low pass filters may be selected for the subcarrier channel and filter characteristics desired. Band pass filters

may be modified to handle a constant percentage deviation frequency system (Standard IRIG) or a DCS constant frequency deviation system. The DCS CBW employs a constant bandwidth using 5 discrete channels for each system. For any frequency between 300 cycles and 200 kilocycles deviation ranges from 4.7% to 40% establishing the above systems and proper bandwidths for the four discrete center frequencies used in direct FM magnetic recording.

1-9. Table 1-1 lists the familiar IRIG center frequencies and their respective channels between 400 cycles and 165 KC. Table 1-2 shows the constant bandwidth standards (DCS). Percentage of deviation for the lowest center frequency in each of the DCS bandwidth standards is 16% and decreases to 4.7% at the highest center frequency. This constant frequency deviation system is a distinct advantage where it is necessary to telemeter the outputs of many identical transducers with precise time correlation between channels. Constant bandwidth also permits more high frequency data recording on tape providing greater bandwidth utilization.

1-10. PHYSICAL CHARACTERISTICS. The Model GFD-5 Discriminator is made up of the basic discriminator chassis which supports the Main Connector Board, 2 plug-in cards, a Power Connector Board, and a Tuning Unit as illustrated in Figure 1-2. Subassemblies are housed in a compact, lightweight, aluminum chassis and cover. The module weighs 1.9 pounds and dimensions are 2.31" x 3.29" x 10.53". A drawer type tuning unit with interchangeable plug-in low pass filters is designed to slide into the front end of the discriminator and engage the connector receptacle mounted at the rear of the chassis. Low pass filters may be removed by applying pressure through the 1-1/4" hole in the top of the tuning unit chassis disengaging the two guide keys and five Elco connectors.

1-11. Other component parts of the main frame are the output deviation meter, three potentiometers and the Main Connector Board with its associated resistors and capacitors. A center shield is employed to isolate stray capacitances and fields between the printed boards. The meter, three pots, a lamp and two test jacks are mounted on the front panel.

1-12. The Power Connector Board couples the module to the power supply connector within the GMA. Printed Board No. 1 is connected to the Main Connector Board at the left hand side of the center shield. This printed board contains the circuitry for the Limiter and the Schmitt Trigger. Printed Board No. 2 is inserted at the opposite side of the center shield and contains the circuitry for the Discriminator and the Low Pass Amplifier. These boards are set in place back-to-back so that the Elco fasteners mesh with those inserted in the Main Connector Board.

IRIG Constant Percentage Deviation Frequency System

Band	Center Frequency (cps)	Deviation (cps)	Lower Limit* (cps)	Upper Limit* (cps)	Maximum Deviation (percent)	Maximum Intelligence Frequency (Modulaton Index 5) (cps)
1	400	±30	370	430	±7.5	6.0
2	560	42	518	602	±7.5	8.4
3	730	55	675	785	±7.5	11
4	960	72	888	1,032	±7.5	14
5	1,300	98	1,202	1,399	±7.5	20
6	1,700	128	1,572	1,828	±7.5	25
7	2,300	173	2,127	2,473	±7.5	35
8	3,000	225	2,775	3,225	±7.5	45
9	3,900	293	3,607	4,193	±7.5	59
10	5,400	405	4,995	5,805	±7.5	81
11	7,350	551	6,799	7,901	±7.5	110
12	10,500	788	9,712	11,288	±7.5	160
13	14,500	1,088	13,412	15,588	±7.5	220
14	22,000	1,650	20,350	23,650	±7.5	330
15	30,000	2,250	27,750	32,250	±7.5	450
16	40,000	3,000	37,000	43,000	±7.5	600
17	52,500	3,940	48,562	56,438	±7.5	790
18	70,000	5,250	64,750	75,250	±7.5	1,050
19	93,000	6,975	86,025	99,975	±7.5	1,400
20	124,000	9,300	114,700	133,300	±7.5	1,900
21	165,000	12,375	152,625	177,375	±7.5	2,500
A**	22,000	3,300	18,700	25,300	±15	660
B	30,000	4,500	25,500	34,500	±15	900
C	40,000	6,000	34,000	46,000	±15	1,200
D	52,500	7,880	44,625	60,375	±15	1,600
E	70,000	10,500	59,500	80,500	±15	2,100
F	93,000	13,950	79,050	106,950	±15	2,800
G	124,000	18,600	105,400	142,600	±15	3,700
H	165,000	24,750	140,250	189,750	±15	5,000

* Rounded off to nearest cycle.

** Bands A through H are optional and may be used by omitting adjacent bands as shown in the following table. In the process of recording the foregoing subcarriers on magnetic tape at a receiving station, provision may also be made to record a tape-speed-control tone and tape-speed-error-compensation signals.

Band used	Omit bands —
A	13, 15 and B
B	14, 16, A and C
C	15, 17, B and D
D	16, 18, C and E
E	17, 19, D and F
F	18, 20, E and G
G	19, 21, F and H
H	20 and G

If a 100 KC tape speed compensation tone is mixed with these bands, the 93 KC band must be omitted and the 124 KC band must not be deviated ±15%.

Table 1-2. DCS, Constant Bandwidth System

Constant Bandwidth Standards	± 1 KC	± 2 KC	± 4 KC	± 8 KC
Frequency Center	6.25 KC 10.00 KC 13.75 KC 17.50 KC 21.25 KC	12.50 KC 20.00 KC 27.50 KC 35.00 KC 42.50 KC	25 KC 40 KC 55 KC 70 KC 85 KC	50 KC 80 KC 110 KC 140 KC 170 KC
Magnetic Recording Standards	40% Deviations * 13.5 KC, 27.0 KC, 54.0 KC, 108.0 KC			

* Not suitable for multiplexed subcarrier usage.

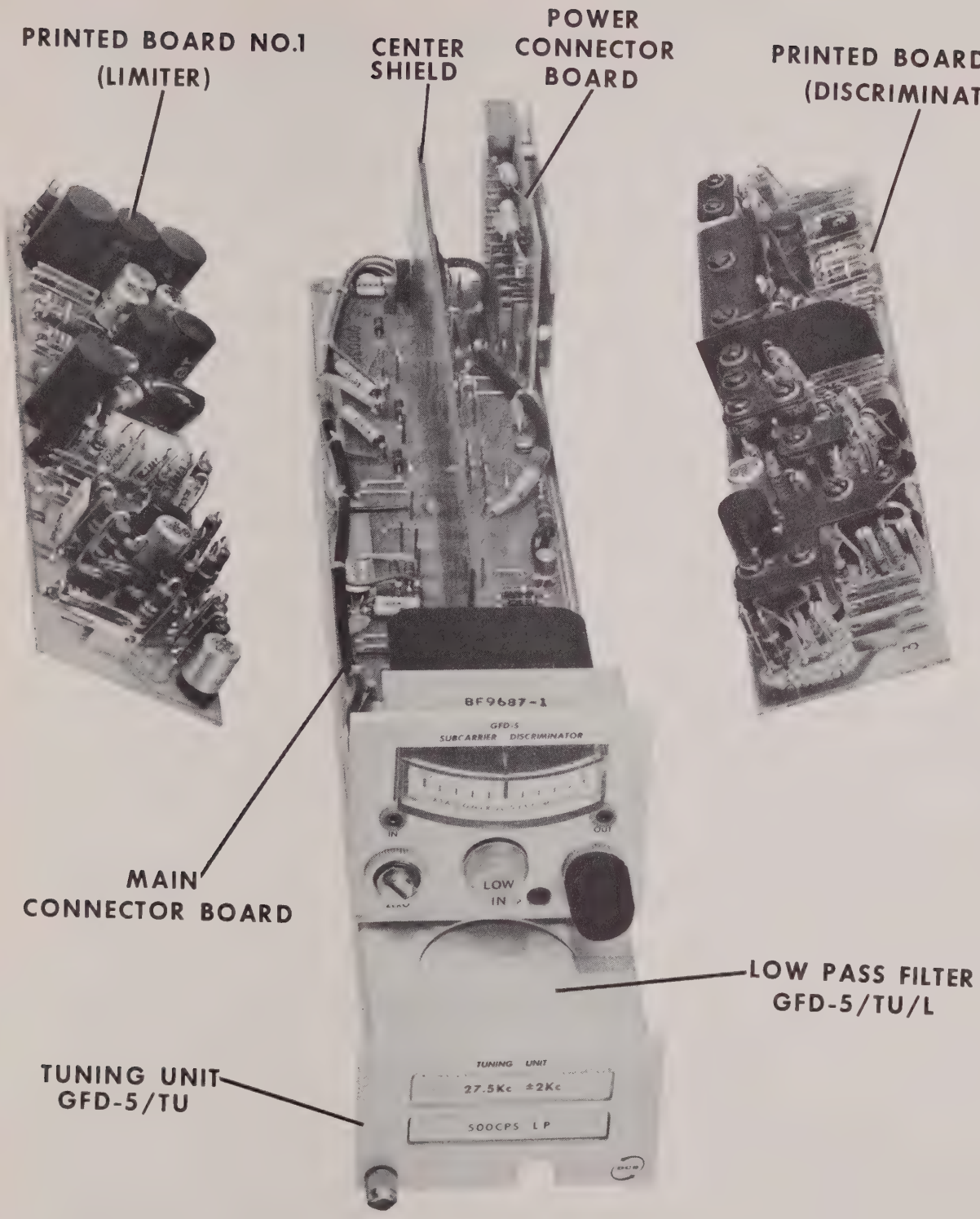


Figure 1-2. Subcarrier Discriminator, Model GFD-5 showing subassemblies.

1-13. The aluminum cover is U-shaped and is screwed to the main frame. The back of the unit is left open to receive cooling air from the rack. Raised portions of the cover fit grooves milled in the bottom of the GMA Module Assembly so that connectors and captive screws are quickly lined up. The GFD-5 occupies a double module space in the GMA assembly which means seven discriminators may be accommodated in one 19" x 3-1/2" rack.

1-14. Color is aluminum with a brushed satin finish. Lettering is black.

1-15. ELECTRICAL CHARACTERISTICS. The Model GFD-5 pulse averaging discriminator is noted primarily for superior linearity, low distortion, and its capability for excellent tape speed compensation over a greater range of frequencies and deviations. Distortion is less than 0.75% of the total output for a modulation index of 5 or more. The output voltage versus frequency curve lies within ±0.1% of full bandwidth for deviation up to ±16%, and is ±.25% for deviation from ±17% to ±40% up to a center frequency of 108 KC. Drift is less than 0.5% of bandwidth from the best straight line for 15 hours after a 15 minute stabilization period. Tape speed compensation will show a 20 db minimum improvement in flutter from d-c up to cutoff frequency with a modulation index of 5.

1-16. Signals may be received from an FM telemetry receiver, reference oscillator-mixer, magnetic tape recorder or FM test oscillator, providing the amplitude of the signal ranges between 10 MV and 10 volts. Input impedance is greater than 100 K ohm shunted by 50 uuf. Between 300 cycles to 200 kilocycles the discriminator will operate over a 60 db input range without lowering performance when operating at the minimum input level. A 20 db amplitude step change in level of a subcarrier at band center will produce less than 1.0% of bandwidth output noise when a low pass filter with a modulation index of 5 is used.

1-17. Output is adjustable from ±0.5 to ±10 volts at full bandwidth deviation with a current of at least 0.050 amperes. Output noise is less than 0.1% rms at maximum gain for a modulation index of 5. An adjacent subcarrier 16 db larger than the desired signal produces less than 0.1% of bandwidth output noise with the signal carrier at center frequency and with a low pass filter having a modulation index of 5 or greater.

1-18. Where pulse or transient type signals are used, a low pass filter with linear phase characteristics may be inserted into the tuning unit. With the linear phase filter, amplitude response falls off gradually and is down 12 db one octave above normal cutoff frequency as shown in Figure 1-3. Asymptotic slope is -18 db per octave up to a cutoff frequency of 5 KC which means that the linear phase amplitude characteristics curve will pass through a -30 db at the 2nd octave above normal cut-off frequency. Above a cut-off frequency of 5 KC

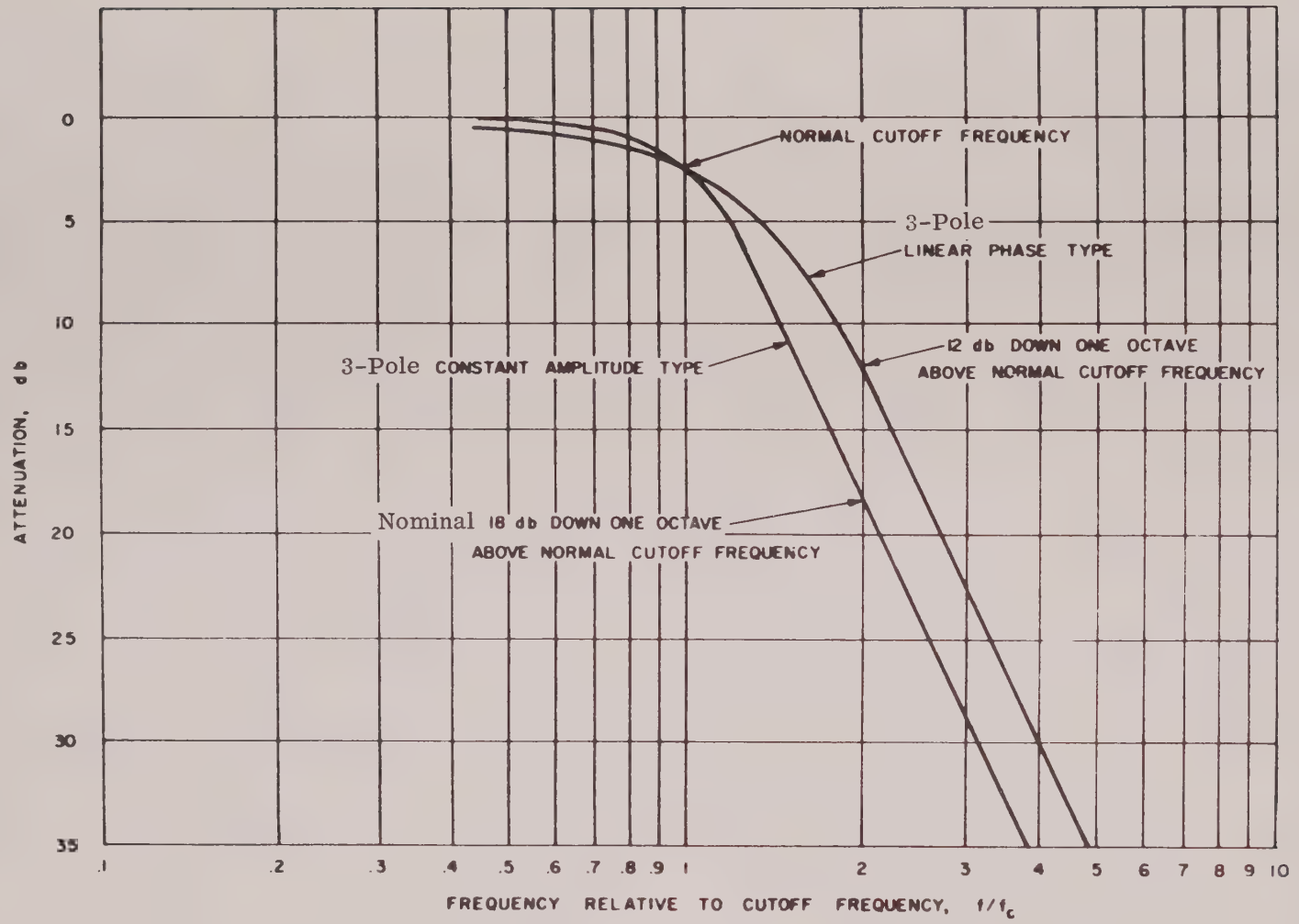


Figure 1-3. Low Pass Output Filter Amplitude Characteristic, Model GFD-5

response is down 12 db one octave above nominal cutoff with an symptotic slope of 30 db per octave.

1-19. Constant amplitude characteristics are selected by changing the filter and are recommended where flat sinusoidal frequency response is important. This produces a higher output signal-to-noise ratio. Asymptotic slope is -18 db per octave up to a cutoff frequency of 5 KC and -30 db per octave above a cutoff frequency of 5 KC. Amplitude response on a -18 db per octave filter, as illustrated in Figure 1-3, is down 18 db at one octave above cutoff frequency and -35 db (off Chart) two octaves above cutoff frequency. Above a cutoff frequency of 5 KC, the response is down 30 db at one octave above cutoff.

1-20. For constant amplitude filters a step function overshoot of 15% is maximum, 1.5% maximum for 3 pole filters and 2.5% maximum for 5 pole linear phase type filters. A discriminator output voltage in response to a step function change in Subcarrier frequency with both types of filters is illustrated in Figure 1-4.

1-21. CONNECTORS. All external electrical connections are made through Power Connector Board CA-010118 to the UNIDAP Module Assembly receptacle. Elco pin numbers and their destinations for this connector are shown in Table 1-3.

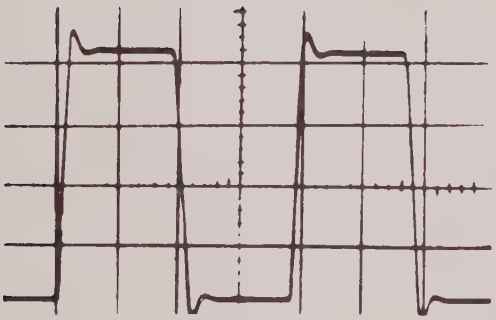
1-22. Interconnection between the discriminator and tuning unit is accomplished through Amphenol connector 57-10240 located beneath and to the rear of the discriminator chassis. Pin numbers and their destinations may be ascertained by locating the pin numbers within the squares marked on the overall schematic diagram.

1-23. Model GFD-5 may be connected for operation with tape speed compensation, as a reference discriminator or for normal operation as described in Section II.

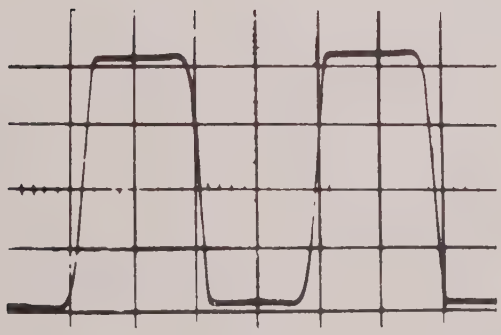
1-24. FUSE COMPLEMENT. There are no fuses used in the GFD-5 module. A protective measure is incorporated in the Module Assembly GMA which detects overloads in the output circuits and will cutoff all supply voltages to the GFD-5.

1-25. QUICK REFERENCE DATA. The information in this paragraph is duplicated elsewhere in this manual and is listed here for quick reference only.

a.	Input Levels:	10 MV to 10 V
b.	Input Impedance:	100 K or greater shunted by 50 uuf
c.	Input Frequencies:	300 cps to 200 KC ±4.7% to 40% deviation
d.	Deviation Polarity:	From band center; increasing frequency - positive voltage. Decreasing frequency - negative voltage



Constant Amplitude



Linear Phase

Figure 1-4. Step Function Response of Low Pass Output Filters

Table 1-3. Power Connector Board Pins

Pin No.	Description
1	Signal Lead Output
2	Signal Lead Output Ground
3	+35 Volts D.C.
4	+12 Volts D.C.
5	Ground
6	W & F Input
7	-12 Volts D.C.
8	-35 Volts D.C.
9	+18 Volts unregulated
10	-18 Volts unregulated
11	Reference Gain
12	Subcarrier Monitor
13	Tied to Pin 5
14	Tied to Pin 5
15	No Connection
16	No Connection
17	No Connection
18	Signal Lead Input Ground
19	Signal Lead Input
20	Signal Lead Input Ground

e. Output Voltage: Continuously variable from ±0.5 to ±10 volts for full bandwidth

f. Output Frequency Response: DC to 25 KC

g. Output Current: At least 100 milliamperes maximum

h. Capacitive Loading: At maximum gain, the output amplifier is capable of tolerating a 0.01 mfd capacitive load without stability

i. Output Noise: Less than 0.1% rms of bandwidth at full output with specified input level and low pass filter modulation index equal to 5

j.	Adjacent Channel:	An average adjacent IRIG channel signal 16 db larger than the desired signal produces less than 0.1% of bandwidth output noise when the carrier is at band center and a modulation index of 5.0 output filter is used
k.	Output Impedance:	.75 ohms or less
l.	Amplitude Modulation	A 20 db step change in signal level, within the specified input range, will produce less than 0.5% of bandwidth output noise when the carrier is at band center and a modulation index of 5.0 output filter is used. When a modulation index of 2.0 output filter is used output noise is less than 1% of bandwidth
m.	Static Linearity:	Independent linearity does not exceed 0.1% of full bandwidth for deviation percentages up to ±16%. Independent linearity does not exceed 0.25% of full bandwidth for deviations from ±17% to ±40% up to a center frequency of 108 KC
n.	Dynamic Linearity:	Distortion of alternating signals is less than 0.75% for modulation indices greater than 5.0
o.	Short-Term Drift:	Less than 0.25% of bandwidth from best straight line for one hour after a 15 minute stabilization period
p.	Long-Term Drift:	Less than 0.5% of bandwidth from best straight line for 15 hours after a 15 minute stabilization period
q.	Tape Speed Compensation:	20 db minimum attenuation of flutter frequencies up to channel cutoff frequency MI-5 with subcarrier located anywhere within the band
r.	Power Requirements:	All voltages supplied by DCS GMA UNIDAP Module Assembly. 6.5 watts maximum per unit

1-26. POWER REQUIREMENTS. Voltages listed below are supplied by the GMA Module Assembly and are rated at 6.5 watts per module.

+12 vdc at 250 ma	-	pin 4
-12 vdc at 250 ma	-	pin 7
+18 vdc at 750 ma	-	pin 9
-18 vdc at 750 ma	-	pin 10
+35 vdc at 150 ma	-	pin 3
-35 vdc at 150 ma	-	pin 8

1-27. FUNCTIONAL DESCRIPTION.

1-28. GENERAL. FM discriminators of the pulse-averaging type are used in telemetry to convert frequency change into proportional changes in voltage. The input multiplex consists of a composite of the subcarrier frequencies, originally modulated by transducer voltages, which are applied to the FM transmitter. The multiplex received is usually fed to a bank of discriminators or a magnetic tape recorder. For IRIG multiplexes, DCS pulse-averaging discriminator is superior to other discriminators unless special techniques are used. The distortions due to wide band coupled-tuned circuits in the ratio detector types and loop filter in the phase locked loop types are not present in a pulse-averaging discriminator. Figure 1-5 illustrates a block diagram of a single discriminator sampling IRIG channel number 3.

1-29. A band pass filter is used to separate a discrete channel, or band of frequencies, (i.e., 730 cycles ±55 cycles) from the composite signal. The output of the band pass filter for channel 3 is a frequency modulated sinusoidal waveform varying about the 730 cycles ±55 cycles center frequency. The DCS band pass filter is a highly controlled five-pole network. Both variation of time delay and the absolute time delay are carefully controlled and matched against company standards. Proprietary test equipment designed for time delay correlating has been designed and is in use for this express purpose. This special equipment along with mass production techniques insure very tight control and a very uniform product. Variation of time delay in production quantities is half that of adjacent channel rejection. This low variation reduces dynamic distortion at low modulation indices and permits automatic tape speed correction. The additional adjacent channel rejection reduces the beats due to crosstalk between channels. This is extremely important when Gaussian characteristic low pass filters are used.

1-30. The output of the band pass filter is fed to a limiter where the signal is shaped to a fixed amplitude square wave at the subcarrier frequency. Variations in amplitude do not affect the output signal as long as the discriminator input level remains within the proper range. Extremely broad limiter-discriminator bandwidth, so important in any multiplexed system, along with high gain, is the function of this design. Dynamic distortion due to attenuation or phase shifting of the information power containing sidebands is reduced. Distortions and offset due to amplitude modulation of the input subcarrier is eliminated.

1-31. The function of the Schmitt trigger is to generate two differentiated pulses which occur at the limiter axis crossing. Since the Schmitt trigger operates on a direct voltage level, its

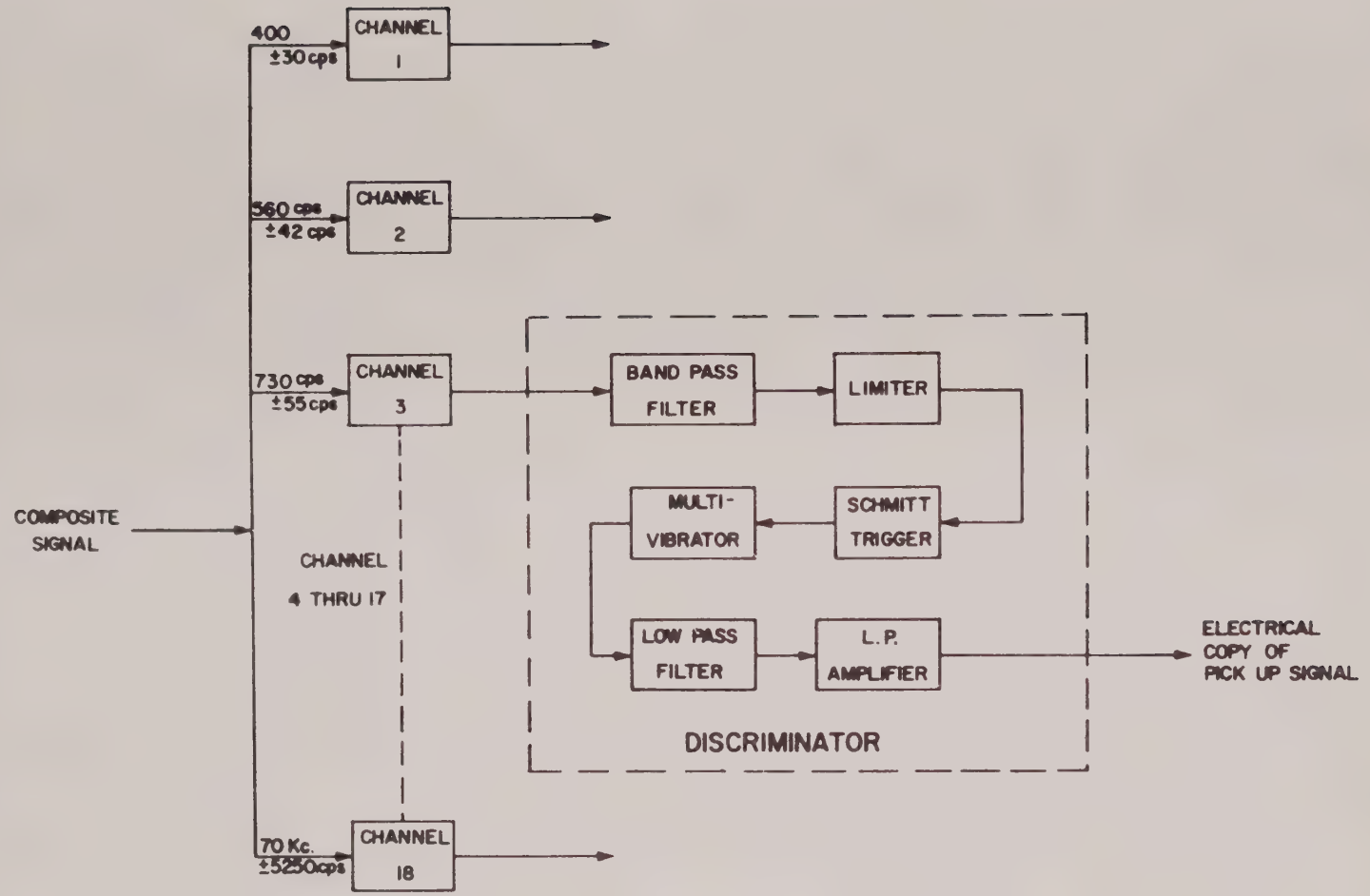


Figure 1-5. Block Diagram of Pulse Averaging Discriminator Sampling IRIG Channel No. 3.

very fast switching time is independent of the input waveform. Therefore, trigger pulses to the discriminator of constant amplitude are generated at the limiter axis crossing, independent of channel frequency or input amplitude.

1-32. Positive going trigger pulses start the monostable multivibrator action. Each half cycle of the subcarrier produces a pulse of constant duration. The average voltage of this series of pulses is proportional to the subcarrier frequency. Pulses are generated at each axis crossing, giving two trigger pulses per subcarrier cycle. Since two trigger pulses per subcarrier cycle are used, the monostable multivibrator actually runs at double subcarrier frequency.

1-33. A low pass filter consisting of an operational amplifier and a frequency determining network removes the subcarrier frequency components allowing only the average voltage to pass. At low frequencies, a Rauch filter network is used to eliminate inductors and reduce the size of capacitors. At high frequencies, RLC networks are used in order to improve high frequency characteristics. Since the input to the low pass filter is actually double subcarrier frequency, the filtering problem is less acute and a three-pole output filter gives results comparative to a six-pole output filter in a single frequency type unit. The exception to this is that the three-pole low pass filter overshoot due to square wave data is approximately two-thirds of the six-pole case.

1-34. Since the frequency voltage characteristic is inherently linear, frequency input is coverted to a voltage output and the resulting signal is a duplication of the transducer signal.

1-35. BAND PASS FILTER. Channel selection is accomplished by means of a 5-pole Gaussian band pass filter composed of five staggered tuned stages. (See Figure 1-6.) Each stage is set at predetermined pole frequencies and Q's along the band to provide a very linear phase response. The sections are isolated by common collector current sources. These configurations have very high input impedances and eliminate detuning of previous stages and mutual coupling between stages. Current source gains are adjusted to equalize pole voltage amplitudes giving the filter a large dynamic range. Proprietary test equipment has been developed to accurately set pole locations and Q's, and to adjust the envelope delay variation very precisely in accordance with the theory presented by Naval Ordnance Laboratory, Corona, in their Report #553.

1-36. The input subcarrier multiplex is applied to pin 19 through R51 to the first parallel tuned section. R51 and the tuned section form a frequency sensitive voltage divider allowing signals near the pole frequency to pass to the base of Q1101 and shunting signals above and

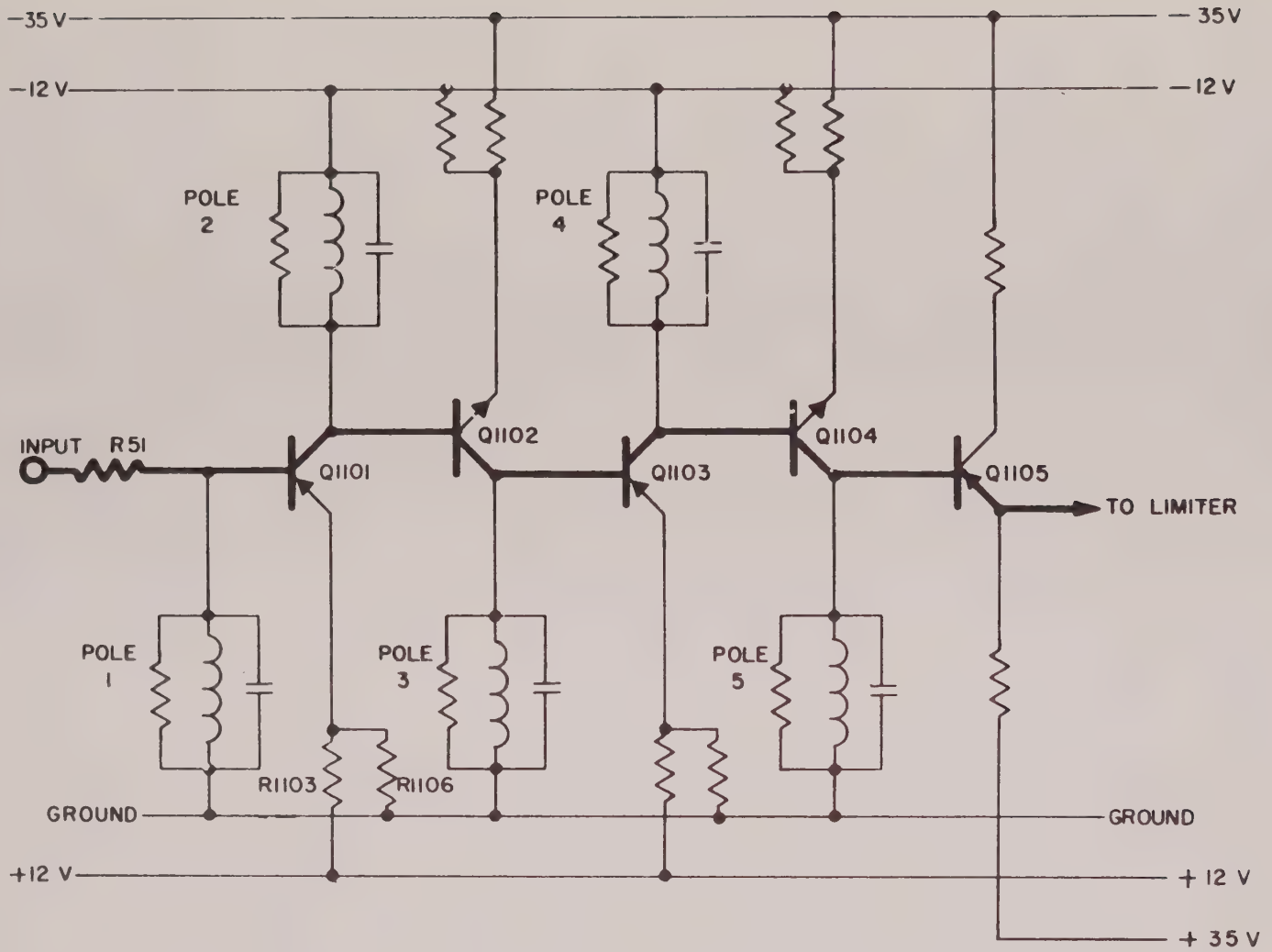


Figure 1-6. Band Pass Filter, Simplified Schematic

below the pole frequency to ground. Voltage applied to the base of Q1101 in conjunction with R1103 and R1106 generate a current which is fed through Q1101 collector into the second parallel tuned stage. Signals are passed from stage to stage in a like manner until they arrive at the base of Q1105. Q1105 is an emitter-follower power amplifier used to drive the limiter and to isolate the limiter from the 5th pole of the filter.

1-37. The input voltage divider has a attenuation of 20 to 1. Gain through the rest of the stages to the emitter of Q1105 is approximately two times. Therefore, the overall gain of the input filter is one-tenth at the input to the first limiter. The large attenuation of the first pole and the large resistor at the input isolates the first pole from the signal source. This isolation allows the source impedance to vary widely without affecting the frequency or Q of the first pole.

1-38. LIMITER AND SUBCARRIER MONITOR. The output of the band pass filter is a sine wave of channel subcarrier frequency which has been separated from the multiplex and is one-tenth its original amplitude. The original amplitude may vary as much as 60 db. This waveform is now fed into a two-section limiter in order to provide a constant amplitude output over the specified input range. (See Figure 1-7.)

1-39. The output of the band pass filter goes through R201 to the base of Q201, which is an emitter-follower amplifier used exclusively to drive the subcarrier monitor jack. Q201 provides a low impedance output effectively decoupled from both the limiter and the band pass filter for subcarrier monitoring purposes. Under normal circumstances, connections to subcarrier jack will not affect the operation of the unit. Under extreme circumstances where the subcarrier monitor jack for subcarrier monitor connection at the rear were grounded, the unit will still operate, because of the high base impedance in Q201. However, this type of operation is not desirable. Subcarrier monitoring is substantially distortionless over the specified input level range.

1-40. The input to the limiter from the band pass filter also goes through R204 to the base of Q202, the first limiter. Q202 is a voltage amplifier with a gain of 10. A voltage limiting diode network CR201 and CR202, at the base of Q202 prevents the input waveform from exceeding 3/10 volt peak. C201 prevents average current flow-through R203 insuring symmetrical limiting. A similar diode limiting network CR203 and CR204, is connected to the collector of Q202. The output of Q202 is fed into an emitter-follower power amplifier Q203 which drives the second limiter.

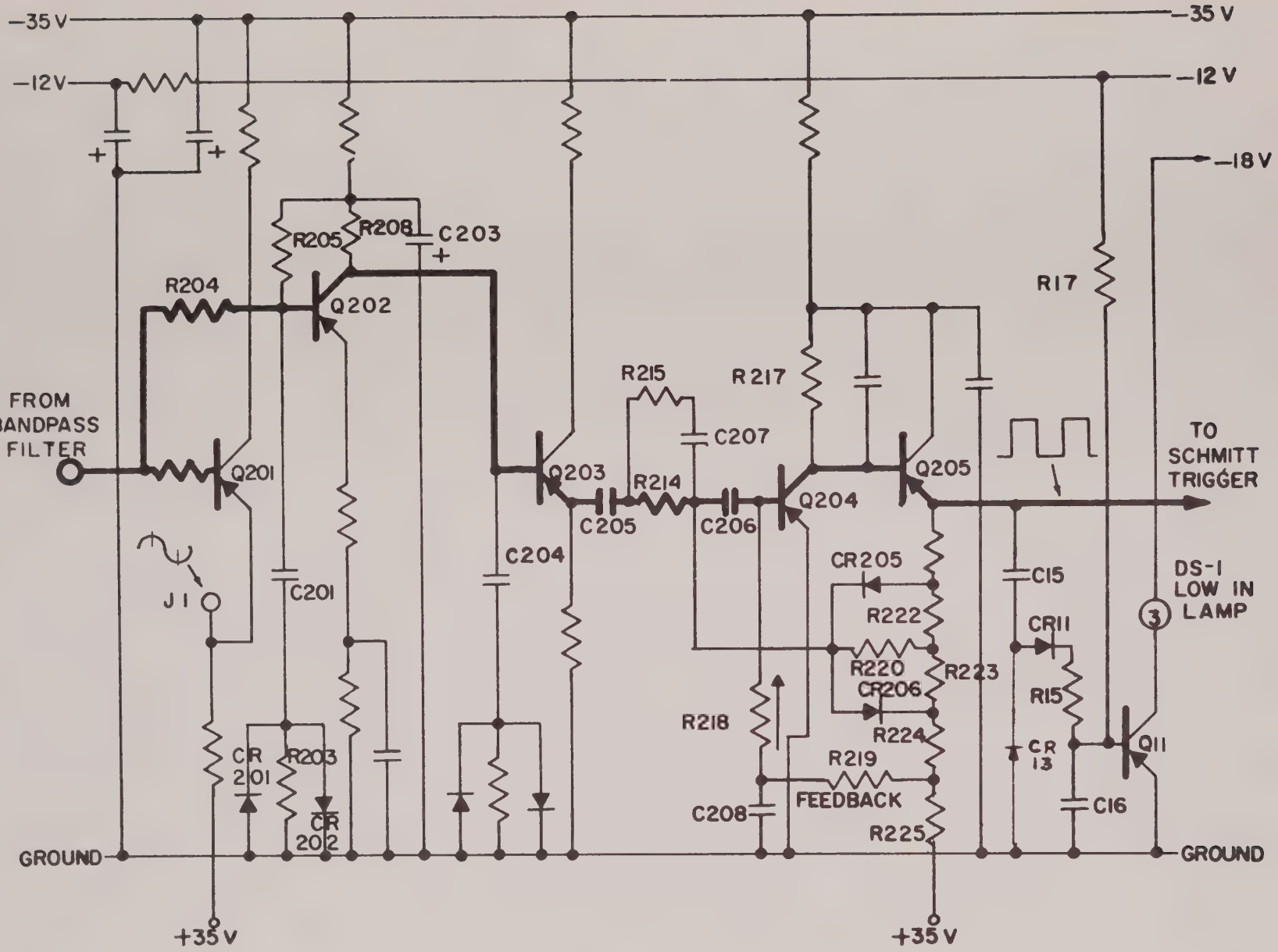


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Figure 1-7. Limiter, Subcarrier Monitor and Input Range Indicator Circuit, Simplified Schematic

1-41. The second limiter is a high gain operational amplifier with negative feedback. The output from Q203 drives the operational amplifier consisting of voltage amplifier Q204 and emitter-follower power amplifier Q205. Direct current feedback through R218 and R219, decoupled by C208, determines the operating point of Q204. A current flows in the emitter of Q205 determined by the emitter resistors and the collector voltage of Q204. If the collector voltage should start to drift in a negative direction, the base of Q205 goes negative and the emitter current increases. The voltage at the junction of R224 and R225 goes a proportional amount more negative. This increases the drop across R219 and R218 and increases the current flow out of the base of Q204. Increased base current causes increased collector current and the collector voltage is returned in a positive direction to its original operating point. All other direct currents to the base of Q204 are blocked by C206 and C205.

1-42. Alternating voltage gain is determined by R214 and R220. There can be no average drop across either of these resistors because of the blocking action of C206 and C205. If the voltage gain of Q204 is high, the small signal operational amplifier gain approaches $G \sim \frac{R220}{R214} \sim \frac{R_{feedback}}{R_{input}}$. As the amplitude of the output waveform increases to about 6 volts peak-to-peak, CR205 and CR206 will start to conduct on the waveform peaks. When this happens, the resistance of R220 will be shunted with the forward impedance of the diode in question which is less than 100 ohms. The gain equation shows that

$$G_o \sim \frac{511\ K}{.909\ K} \qquad \text{changes to} \qquad G_c \sim \frac{.1\ K}{.909\ K}$$

as the diode changes from its open-to-closed stage. Therefore, the operational amplifier may be thought of as operating class A and gain is greatly reduced when the level determined by R222, R223, and CR205 and CR206 is reached. This prevents both transistors from saturating or cutting off and greatly reduces the charging times of stray capacities and junction storages and results in a very broad band limiter.

1-43. Bandwidth is further increased by the peaking action of R215 and C207 which shunt the impedance of R214 in the gain equation at high frequencies. The limiter output from the emitter of Q205 is used to drive the level indicator circuit. When the limiter output level is sufficient to operate the discriminator, it turns off the low level indicator light DS1. Q11 is a collector loaded amplifier with a low level indicator light DS1 in its collector circuit. R17 biases Q11 on lighting DS1. The limiter output signal is coupled through C15 into the peak detector consisting of R16, CR11, R15, and C16. When the limiter output is sufficient to

operate the discriminator circuitry, the peak detector charges C16 in a positive direction a sufficient amount to turn off Q11. When this level is reached, DS1 goes out. It should be noted that DS1 indicates an operating level sufficient to correctly trigger the discriminator and therefore will go out before the specified minimum input level is reached. The circuit will normally operate at lower input levels than are necessary to extinquish DS1; however, if DS1 lights, the quality of the resulting data should be examined.

1-44. The waveform on the emitter of Q205 is a constant amplitude square wave of subcarrier frequency. This signal has an amplitude of approximately 6 volts if the discriminator input is within the specified limits. The output of the limiter passes on to the Schmitt trigger and pulse amplifier circuit.

1-45. SCHMITT TRIGGER AND PULSE AMPLIFIER. The output from the limiter is a square wave of constant amplitude at subcarrier frequency. Since a monostable multivibrator is going to be used for a demodulator, a trigger for this multivibrator circuit must be generated. Since it is impossible to have a perfect square wave at all input frequencies and levels, triggering must be accomplished on the limited subcarrier waveform axis crossing.

1-46. The Schmitt trigger or cathode coupled trigger (see Figure 1-8) is composed of two transistors sharing a common emitter resistor. The units are cross-coupled from the first collector to the second base. When the trigger is operating correctly, the switching time is dependent on the biasing and the circuit parameters and not on the rate of change of input voltage. Triggering is accomplished when the input signal passes through a predetermined voltage level.

1-47. As the input signal to the base of Q301 passes through the predetermined level in a positive going direction, Q301 starts to turn on. Q301 emitter follows Q301 base in a positive direction and Q301 collector voltage goes negative. This, in turn, drives the base of Q303 in a negative direction. At the same time, however, the emitter of Q303 is being drawn positive by the action of the common emitter resistor R305 and the emitter of Q301. This turns Q303 sharply off. The combined effects of the base being driven negative and the emitter positive on Q303 and the fact that current no longer flows through Q303 makes this switching action very fast. On the next half cycle, with the input signal in the negative going direction, the emitter of Q301 follows negative until the emitter of Q303 passes the pegged base voltage of Q303. At this time, Q303 starts to turn on and the reverse process described above switches the trigger in the other direction. As in the first case, the combined feedback of Q303 base drive and the common emitter resistor cause the switching action to be

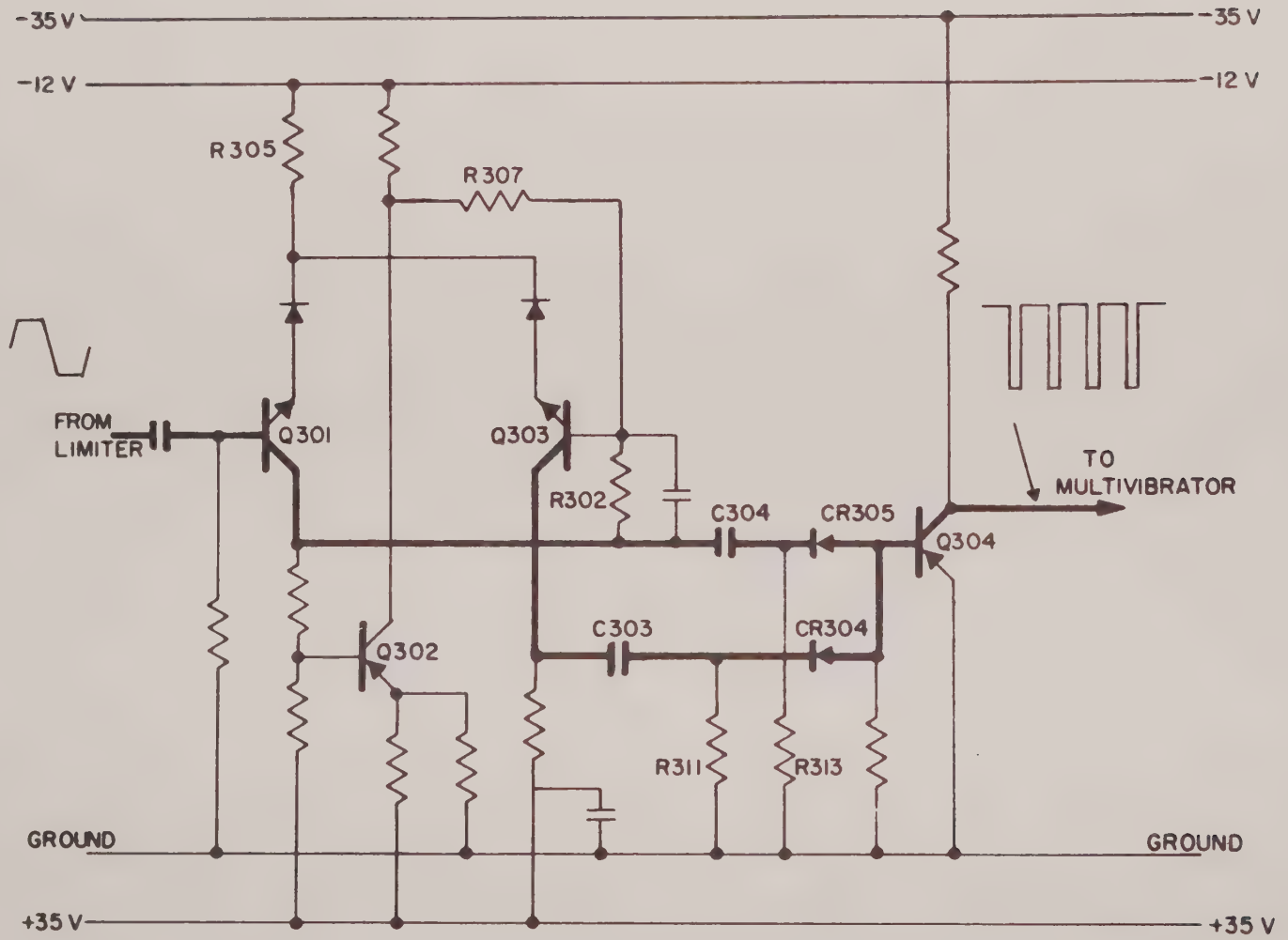


Figure 1-8. Schmitt Trigger and Pulse Amplifier, Simplified Schematic

very rapid. A square wave appears on the collector of Q301. Both of these waveforms, however, have extremely short transition periods. Both of these collector waveforms may be differentiated to form pulses.

1-48. It should be noted that the predetermined voltage for firing in the positive going direction is not the same as the predetermined voltage for firing in the negative going direction if Q301 collector moves over a reasonable voltage range. However, unless Q301 collector and Q303 base do move over a sizeable voltage during switching, sufficient feedback for good operation will not be present. Therefore, a high frequency operation with short rise and fall times make it imperative to have this fire and refire hysteresis.

1-49. Q302 is a current source whose collector is connected to the base resistor of Q303. The base of Q302 is connected to the split collector load of Q301 sensing the state of Q301. Depending on the state of Q301, Q302 delivers a current to the base bias resistor of Q303. In this manner, the bias of Q303 is changed depending on the state of Q301. If the current determining resistors in the emitter of Q302 and the base bias resistors in the base of Q303 are determined correctly, we can arrange the bias on Q303 so that the input firing point in the positive going direction is the same as the firing point in the negative going direction. This allows the Schmitt trigger to fire on both axis crossings of the limiter waveform. If there is a delay in the operation of the Q302 circuit, the bias on the base of Q303 will not be changed until after the Schmitt trigger has completed its switching. Therefore, the hysteresis will be present during the switching time and fast switching with short rise and fall time will result. The hysteresis has not been reduced. It has been shifted after the switching has taken place. We now have a pair of out of phase square waves on the collectors of the Schmitt trigger. The transition of these square wave in both directions occur at the subcarrier frequency axis crossings. The rise times of both of these waveforms are independent of the channel frequency or amplitude.

1-50. These waveforms are differentiated by C304, R313, C303, and R311, to obtain trigger pulses. The trigger pulse amplitude and rise times are the same for any channel frequency or input level included in the specifications. Negative trigger pulses are selected by CR305 and CR304 and presented to the base of Q304. This results in a negative trigger pulse every subcarrier axis crossing or two trigger pulses per cycle. These trigger pulses are amplified in both voltage and power level by Q304. A large positive pulse occurs at the collector of Q304 at every subcarrier axis level crossing. These pulses trigger the monostable multivibrator demodulator.

1-51. DISCRIMINATOR. The output of the Schmitt trigger and pulse amplifier is a trigger pulse train. Each trigger pulse occurs at the channel subcarrier axis crossing. The information as to channel subcarrier frequency must be extracted and compared against the standard for that channel.

1-52. A monostable multivibrator (see Figure 1-9) is used to generate a negative square pulse of constant accurate duration for every trigger pulse generated by the Schmitt trigger. The resultant average voltage is then proportional to the subcarrier frequency. These pulses occur at every limiter axis crossing or at double the subcarrier frequency.

1-53. A positive pulse from Q304 is introduced through CR402 to the base of Q403. The emitter-follower action of Q403 turns off Q404. Cross coupling from Q404 collector to Q405 base turns on Q405. Q405 collector, as it turns on, reinforces the pulse to Q403 base. CR402 automatically disconnects the pulse generator after the monostable action takes over. Collectors of both Q404 and Q405 are clamped in on and off positions by the diode networks.

1-54. When Q404 is turned off by the input trigger, its collector goes from the ground clamp to the negative clamp. This induces in the base of Q405 an almost equal voltage change due to the action of zener diode CR412 and R414 and R413. Q405 emitter follows and so does CR410 and its side of timing capacitor C1401. Since this is a fast transition CR409 side of C1401 has an equal voltage step. At this time, Q405 collector turns on from the negative clamp to the ground clamp. Q403 base voltage charges to $\frac{R406}{R406 + R408}$ x 35 volts, moving in the positive direction, and carrying Q404 base with it. This action puts a large voltage bias on Q404. Note that both Q404 base and CR410 side of C1401 are pegged by the collector clamping action. Current through Q405 can only come from the +35 volt supply through R1, R412 and C1401 since CR411 is biased off by R414 and Q406. The current flow through C1401 is determined by R1 and R412 and the voltage on the CR409 side of C1401. Due to this current flow, the CR409 side of C1401 charges in the positive direction toward the +35 volt supply. When the voltage on the CR409 side of C1401 passes the pegged base voltage of Q404, Q404 turns on. The multivibrator action mentioned above flips the monostable circuit to its original state.

1-55. Since the CR409 side of C1401 will go to $\frac{R406}{R406 + R408}$ times the negative clamp voltage and remain pegged there, the CR410 side of C1401 will jump an equal amount in the negative direction. This is not desired. At this time, the bases of Q504 and Q406 are moved by zener CR412 to a positive voltage. Q406 and CR411 then discharge C1401 so that the

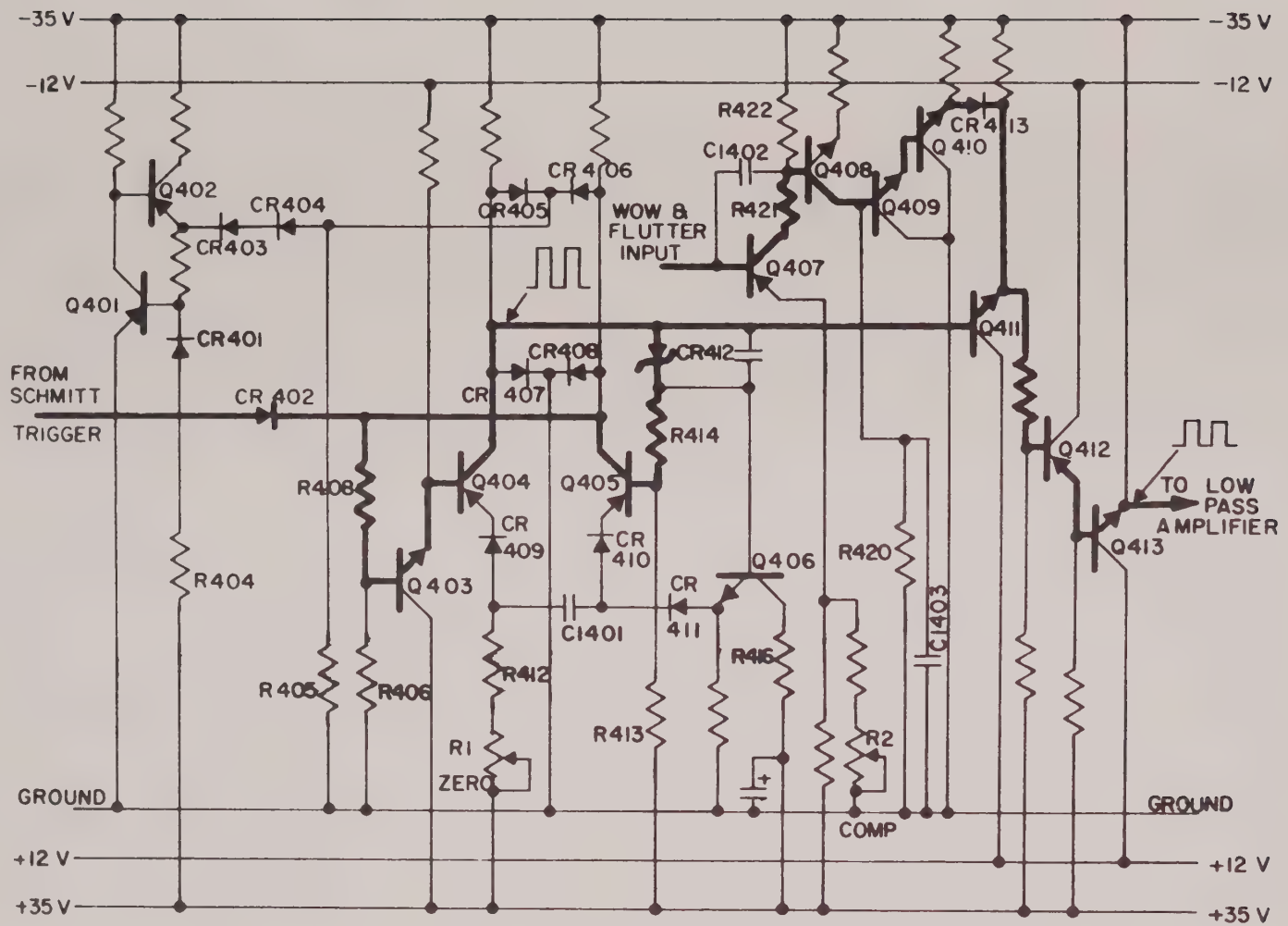


Figure 1-9. Discriminator and Tape Speed Error Correction Circuit, Simplified Schematic

CR410 side is effectively at Q405 base voltage, the cycle is completed, and the monostable multivibrator is ready for another input trigger pulse.

1-56. Collector clamping of Q404 and Q405 are very critical both for circuit operation and for stability. Q401 and Q402 form a power supply of very low impedance for the negative clamp. The other clamp, of course, is directly connected to ground.

1-57. Temperature compensation is accomplished by matching diode junctions wherever possible. CR401 compensates for the emitter base junction of Q401. Q402 needs no compensation. CR403 and CR404 compensate for the collector clamps CR405 and CR407, and CR406 and CR408.

1-58. Variation of the +35 volt supply will change the charging current in the timing capacitor C1401 and change the width of the constant duration pulse. This may be compensated by changing the negative clamp voltage a corresponding percentage. Q401 emitter is connected to ground. Since Q401 base must follow its emitter if the unit is to operate in a class A manner, an increase in the +35 volt supply will increase the drop across the R404 and increase the current through R404. This will increase the current in R403 a similar amount since Q401 collector drives Q402 emitter-follower in a manner to keep Q401 base voltage constant. Therefore, a percentage change in the +35 volt supply will result in the same percentage change in the negative clamp voltage. Increase in the charging current through C1401 is accompanied by an increase in the voltage through which C1401 must charge, which is determined by the collector clamp voltage. First order compensation results.

1-59. The output waveform from the collector of Q404 is a negative pulse with a stable and constant duration, the excursions of which are clamped to specific voltages. This output waveform is fed to the base of emitter-follower power amplifier Q411.

1-60. TAPE SPEED ERROR CORRECTION. When subcarrier multiplexes are recorded on a magnetic tape machine, any variation in tape speed due to machine or tape dynamics will look like an additional frequency modulation of the subcarrier. This results in an error in the data. This error may be compensated by recording a crystal stabilized frequency, discriminating to determine the error due to tape speed variation, and feeding the proper error correcting signal into the discriminator.

1-61. The tape speed error signal to the discriminator is fed thru a resistive divider network into pin 6 of the GMA module space being used. The signal goes to the base of Q407, the tape

speed compensation network input. When tape speed compensation is not used, pin 6 must be grounded at pin 5 in the GMA module used.

1-62. Since the data information is delayed in the data band pass filter, the compensation signal must also be delayed an appropriate amount. The delay is accomplished by a circle diagram all pass phase shifter (Q407, etc.) and a low pass filter (Q408, etc.). The low pass filter also attenuates the tape speed error compensation signal in the same manner as the loss of sidebands in the band pass filter attenuates the data (including the error due to tape speed variation).

1-63. The gain at the emitter of Q407 is nearly one, and the gain at the junction of R421 and R422 is nearly minus one at low frequencies. At very high frequencies, C1402 directly connects this junction to the input, giving a gain of plus one. As the frequency increases from very low, the phase shift slides from 180° to 0° but the amplitude remains constant. This is a circle diagram all pass phase shifter.

1-64. The low pass filter consists of R420 and C1403 in Q408 collector. C1402 and C1403 are situated in the channel selector and are dependent on channel frequency. The attenuation of the compensation low pass filter is approximately 2 db down at the MI = 1, and the delay of both the phase shifter and the low pass section equal the delay of the band pass filter at MI = 5.

1-65. This error signal, with delay properly added for a specific channel, is fed to a Darlington-connected power amplifier (Q409 and Q410). The output of the monostable multivibrator at the collector of Q404 is a negative pulse of constant duration whose amplitude is completely determined by the collector clamp diode circuits. This output is fed to the base of Q411 and the emitter normally follows this waveform. However, the negative excursion of this waveform at the emitter of Q411 is determined by the final output voltage of Q410 and its clamp diode, CR413. Therefore, the negative amplitude of this constant width pulse going into the low pass filter is determined by the tape speed error compensation signal. Since these voltages are directly connected, this modulation of the negative excursion of the constant width pulse will change the average level into the low pass filter an amount corresponding to the tape speed error regardless of the position in the band. Q412 and Q413 are emitter-follower drivers for the low pass filter and present the modified waveform to the low pass filter. R1501 and R1502, (see Figure 1-10) constitute a voltage divider and attenuate the input to the low pass filter. Since this includes the average value of the input to the low pass filter, it results in a deviation sensitivity adjustment.

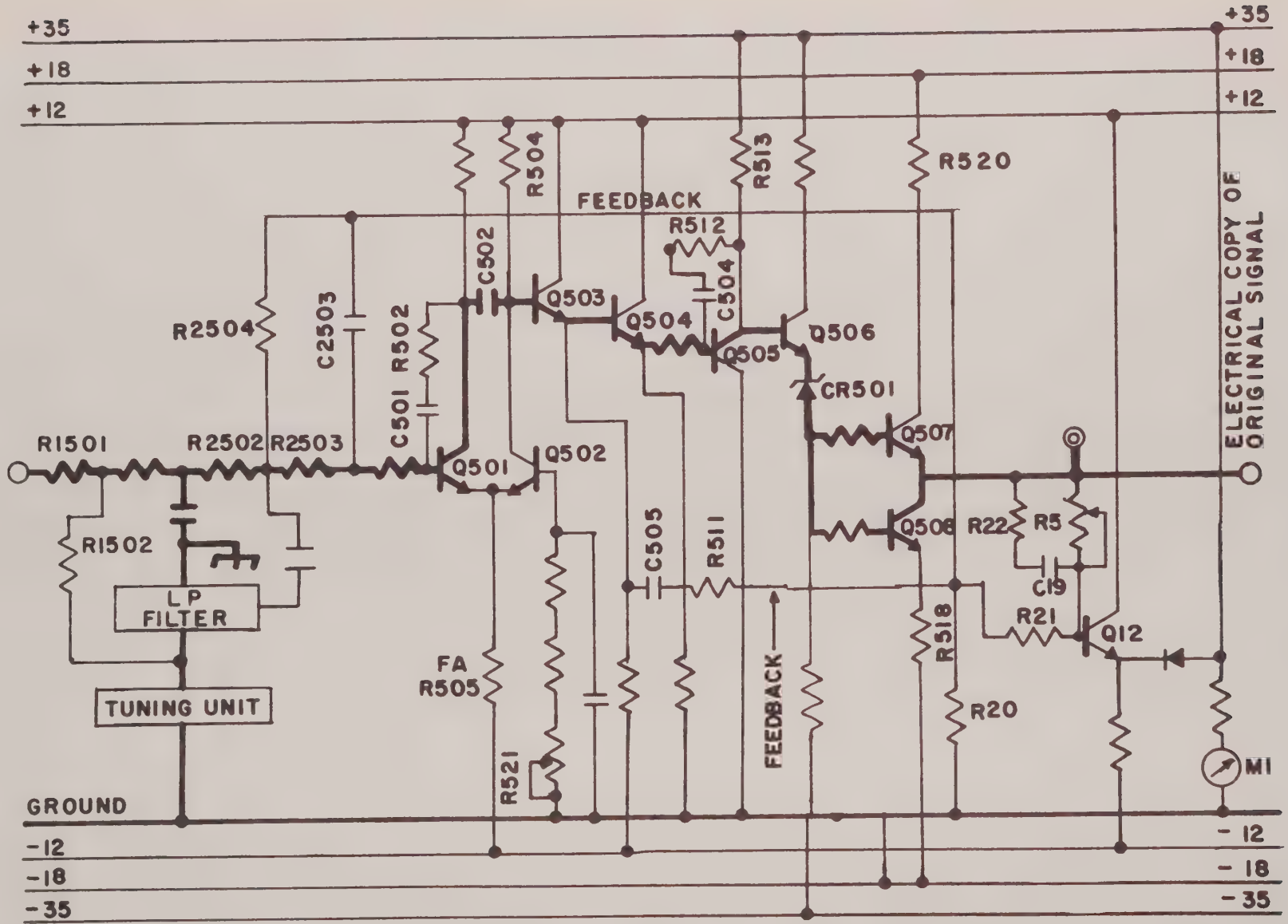


Figure 1-10. Low Pass or Operational Amplifier, Simplified Schematic

1-66. LOW PASS FILTER. The output from the demodulator section is a series of constant width pulses whose average voltage contains the data information. The high frequency components of this pulse train must be removed in order to extract the pure data. This is accomplished by means of a Rauch filter which is an analog of a π section RLC low pass filter. The Rauch filter consists of a frequency sensitive or a frequency determining network and an operational amplifier. The feedback around the operation amplifier in conjunction with the frequency sensitive network produces a pair of complex conjugate poles. This is an analog of an RC tuned circuit. A low frequency filter is realized without inductors and with decreased size of the capacitors. The network may be preceded by an RC real pole to give a 3 pole filter. The selection of capacitor values determine the pole positions of the filter and all classical types of filters may be obtained. At high frequencies, the amplifier may be preceded by an actual LC network, and a capacitor may be inserted in parallel with the feedback resistor to produce a real pole, resulting in an RLC filter at higher frequencies. This approach improves the high frequency response.

1-67. LOW PASS AMPLIFIERS. The operational amplifier (see Figure 1-10) consists of a differential amplifier (Q501 and Q502), several current amplifiers (Q503 and Q504), a current-to-voltage converter (Q505), an emitter-follower driver (Q506), and a power amplifier (Q507 and Q508). Q12 is a meter driver amplifier stage and mainly serves to decouple the dynamics of the meter from the feedback circuit. The feedback is accomplished through the voltage divider, R5, R21 and R20, and then through R2504 and C2503 which are part of the Rauch filter frequency determining network.

1-68. The signal to the low pass filter comes into the base of Q501. Q502's base is grounded through its base resistor and the common emitter connection between Q501 and Q502 modulates Q502. The resulting current waveform appears at the collector of Q502. Since Q505 emitter is grounded, Q504 drives a very low impedance; therefore, Q503 drives a correspondingly low impedance and the collector of Q502 is maintained at several volts above ground. Since the voltage on the base of Q503 does not change, the variation in the current waveform must go through the base of Q503 causing Q503 to be a current amplifier. The resulting current gain in Q503 also does not result in a voltage waveform but goes into the base of Q504. The resulting amplified current in Q504 also passes through the base of Q505. The current gain in Q505 is transformed into a voltage waveform by the collector load R513 since Q506 is basically a high input impedance emitter-follower. Because of the impedance levels between the collector of Q502 and the collector of Q505, most of the amplified current is transmitted

to the base and so the amplifier has a very efficient high current gain. The greatly amplified voltage waveform generated at the collector of Q505 drives emitter-follower Q506. Q506 is separated from the base of Q507 by a zener diode CR501 in order to get a DC offset for bias purposes without sacrificing AC gain. Q507 and Q508 form a power stage which will deliver high currents to the load.

1-69. The feedback which originates from the junction of R21 and R20, is fed back through R2504 to the DC error point, the junction of R2502 and R2503. The high gain in the amplifier, and the feedback network components keep the voltage gain at the junction of R21 and R20 constant at all times. The setting of the potentiometer R5 necessitates a larger or smaller output voltage in order to maintain this signal level at the junction of R20 and R21. In this manner, the gain of the low pass filter may be adjusted.

1-70. Since the output meter M1 is driven from the bottom of the potentiometer, which is effectively from the junction of R21 and R20, the output meter reads in percent of full bandwidth and is independent of the setting of the output gain control R5.

1-71. Output amplifier stability is accomplished through high amplifier gain, feedback and temperature stabilization of Q501 and Q502. Base resistors of Q501 and Q502 are approximately matched and the base resistor of Q502 is adjusted to give zero volts out when R1501 is grounded at pin 2. Temperature compensation is accomplished by adjusting R505, the common emitter resistor. Since R504, the collector resistor of Q502, has a fairly constant drop across it, charging the emitter resistor R505 will cause more or less current to flow through Q501. The differences in the characteristics of the base-emitter junctions of Q501 and Q502 can then be cancelled by running more or less current through Q501. After this adjustment is made, however, the base resistor of Q502 must be readjusted for zero volts out.

1-72. C505 and R511 make up an internal feedback loop while R512 and C504, C502, R502 and C501 are internal stabilization networks. R22 and C19 constitute a stabilization network for R5 and are located on the main connector board. R520 and R518 are current limiting resistors which not only limit the output current but protect the output power amplifier from current overloads.

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. This section describes the initial procedure and instruction required to prepare the Subcarrier Discriminator, Model GFD-5 for operation. The scope of this information covers the functional installation and precludes actual operation of the equipment.

2-3. UNPACKING AND HANDLING.

2-4. The unit is sealed in a moisture proof polyethelene bag and wrapped in Kimpack insulation to absorb shock during shipment. A BNC adapter is furnished for test lead fabrication (see paragraph 3-6).

2-5. Remove the corrugated carton and protective covering and perform a general visual inspection. Look for broken controls and indicators on the front panel and damage to the aluminum case. Retain carton and protective covering until inspection is completed.

2-6. MOUNTING.

2-7. The discriminator is designed to be mounted in the GMA Module Assembly. If the GMA is not wired for the GFD-5, refer to paragraphs 2-10, 2-11 and 2-12. To install the unit in the rack, proceed as follows:

a. Note the module designations on the bottom edge of the GMA Module Assembly. Insert the discriminator, without the tuning unit, into one of double module spaces marked GFD-5, and apply pressure until connectors engage.

b. Fasten the captive screw.

c. Insert the proper low pass filter into the tuning unit for the channel being used and slide the tuning unit into the basic discriminator.

2-8. INTERCONNECTION.

2-9. Interconnection is accomplished between the GFD-5 Elco connector BF 10106-07 (see Figure 2-1) and the GMA Masterboard 20 pin Elco type connector, CS-20-P-100-5203. At the customer's request, the GMA may be factory wired for normal operation, tape speed compensation or as a reference discriminator.

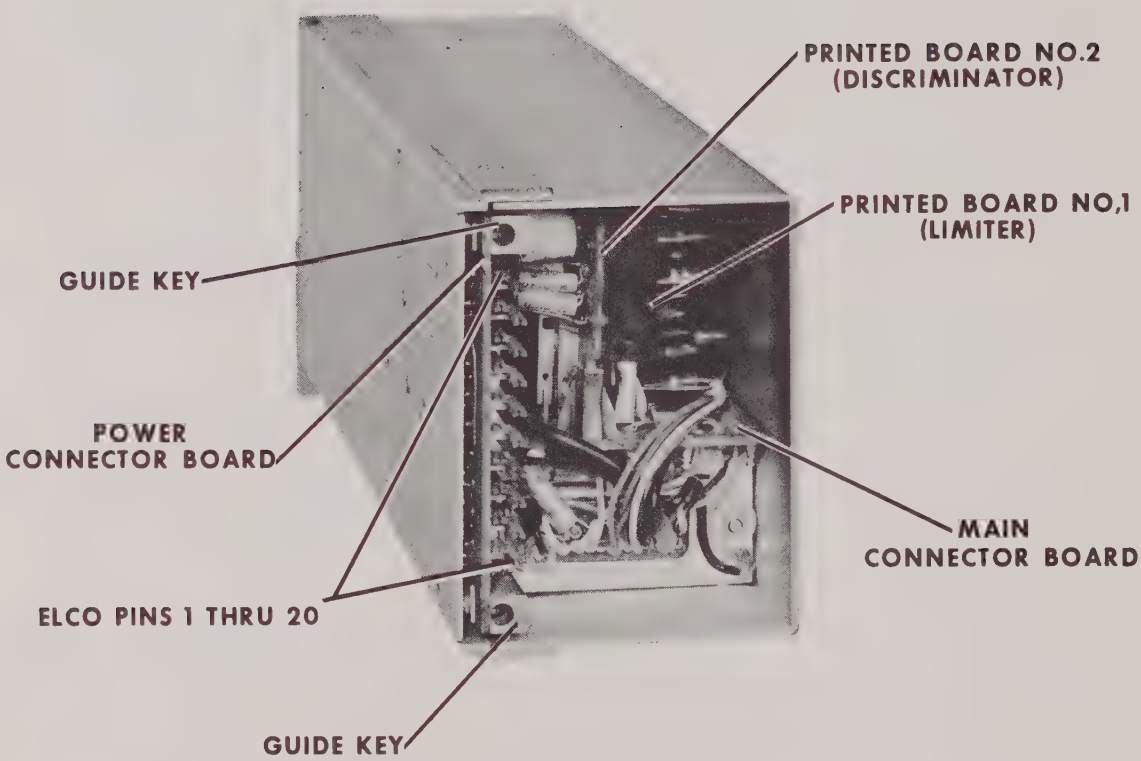


Figure 2-1. Rear View, Model GFD-5

2-10. If the GMA Module Assembly is not factory wired for normal operation and normal operation is desired, the change may be made in the field by referring to Table 1-3 and executing the following changes:

a. Connect pin 1 to pin 11 and pin 5 to pin 6 at the proper GMA connector.

b. Connect input and input ground to coaxial connector at the proper GMA module position (J-300 series).

c. Connect output to pin D and output ground to pin E of the 5 pin connector for the proper GMA module position.

NOTE

Since each GFD-5 discriminator uses two module spaces in the GMA Module Assembly, the BF 10106-07 (GFD-5) connector will normally be in position to engage even numbered GMA connectors.

2-11. If normal operation with tape speed compensation is desired, a field change may be made by connecting all pins as described in paragraph 2-10 with the following exceptions:

a. Do not connect pin 5 to pin 6 .

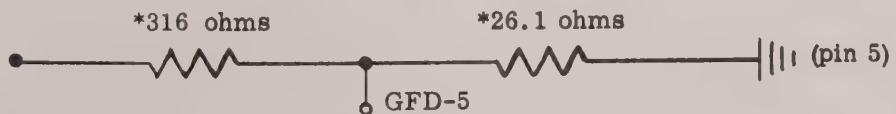
b. Connect pin 6 from all data discriminators together for tape speed error input buss.

2-12. If it is desired to operate the GFD-5 as a reference discriminator, connect the GMA as described in paragraph 2-10 with the following exceptions:

a. Do not connect pin 1 to pin 11.

b. Disconnect reference discriminator input from data discriminator input buss and connect to multiplex input.

c. If the GMA connector board is not wired for reference discriminators, connect the reference discriminator output (pin 1) to ground (pin 5) through the voltage divider shown below. Tap off the voltage divider to data discriminator tape speed error buss (pin 6). Reference discriminator output ground is connected to pin 5 at connector board.



*Use 1/4 watt resistors, 1%

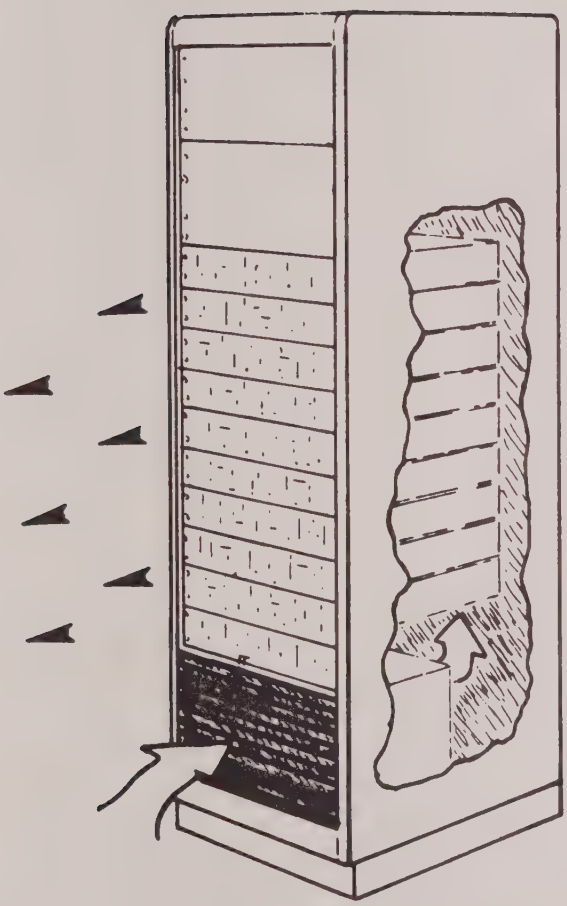
2-13. COOLING.

2-14. Cooling within the rack is accomplished through a blower assembly which is housed at the base of the cabinet. To obtain adequate pressure all vents and screw holes should be plugged, directing the air flow through the discriminator case and out through the crevices in the front panel. (See Figure 2-2.)

2-15. In addition, each GMA Module Assembly is equipped with a muffin fan which pressurizes the unit to approximately 0.2 inches of water and forces cooling air over and through the GFD-5's. This means the equipment may be operated in or out of the rack and maintain its proper temperature as long as the ambient temperature does not exceed 40°C. Additional test equipment or other equipment mounted in the same enclosure requires cooling air supplied at the rate of 40 cfm per 50 watts dissipation.

CAUTION

Excessive cooling, unevenly applied
may impair stability of the unit.



Air flow is 40 cfm per GMA. Installation shall be semi-pressurized to approximately 0.2 in. of water to permit cooling by air flow over and around units.

Figure 2-2. Typical Example of Rack Cooling

SECTION III

OPERATION

3-1. GENERAL.

3-2. This section includes the location and function of operating controls and the procedure required to place the Model GFD-5 in operation.

3-3. LOCATION AND FUNCTION OF CONTROLS AND INDICATORS.

3-4. Controls and indicators are listed in Table 3-1. All controls with the exception of R521 are located on the front panel as illustrated in Figure 3-1.

Table 3-1. Location and Function of Controls and Indicators

Desig-nation	Control and/or Indicator	Location	Function
M-1	Output Deviation Meter	Top of front panel	Indicates percent deviation from center frequency by means of a pointer
DS-1	Low Input Level Indicator	Center of front panel	Indicator lamp illuminates when input level is below the 10 MV to 10 volt range
R1	Zero Control	Screwdriver control on left side of front panel	Adjusts the discriminator output voltage to zero at channel center frequency
R2	Compensation Amplitude Control	Small screwdriver control on lower right side of front panel	Adjusts amplitude of wow and flutter input signal
R5	Gain Control	10 turn control on lower right side of front panel (black knob)	Adjusts output gain
R521	Differential Ampli-fier control	Screwdriver control on Low Pass Ampli-fier printed circuit card	Adjusts differential reference point. (Maintenance only)

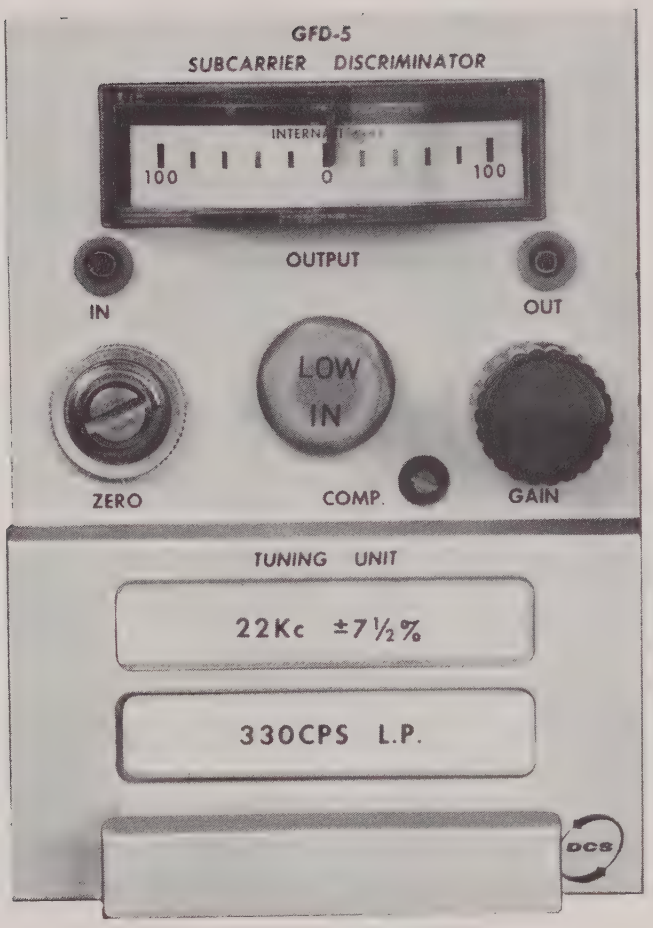


Figure 3-1. Front Panel View, GFD-5

3-5. OPERATING PROCEDURE.

3-6. It is assumed that the GFD-5 has been installed in its rack prior to operation as described in paragraph 2-7. To ensure proper operation of the equipment, proceed as follows:

a. Throw the ON-OFF switch located on the connector panel of the GMA Module Assembly to the ON position.

b. Allow a 15 minute warmup.

c. With the main blower assembly switch in the OFF position, check one of the openings in the panel to be sure the muffin fan in the GMA is operating. If affirmative, turn the main blower on and also check to see if it is operating. When modules are missing from other positions in the GMA, utilize the blank panels GBP-1 or -2 to maintain cooling air pressure.

d. Observe the LOW IN indicator. Lamp should go ON when input is below the 10 MV to 10 V input range. If lamp stays on during operation observe deviation meter. When data is being received the needle may slowly oscillate around a point on the dial or may be stationary. If needle swings all the way to one side and LOW IN lamp remains on, suspect a low input.

NOTE

A coaxial test lead may be fabricated for band center and bandedge adjustments (steps e through h) by obtaining Amphenol UG-692/U or a BNC adapter and a sufficient length of AN type RG-62/U coaxial cable. Splice one end of the cable so that alligator clips may be attached to the oscillator.

e. Obtain a wide range oscillator (Hewlett Packard 200 CD, or equivalent) and apply the proper center frequency to the coaxial input jack at the GMA connector panel (J301 through J314).

f. Adjust the ZERO screwdriver control on the discriminator panel until the deviation meter (M1) reads zero.

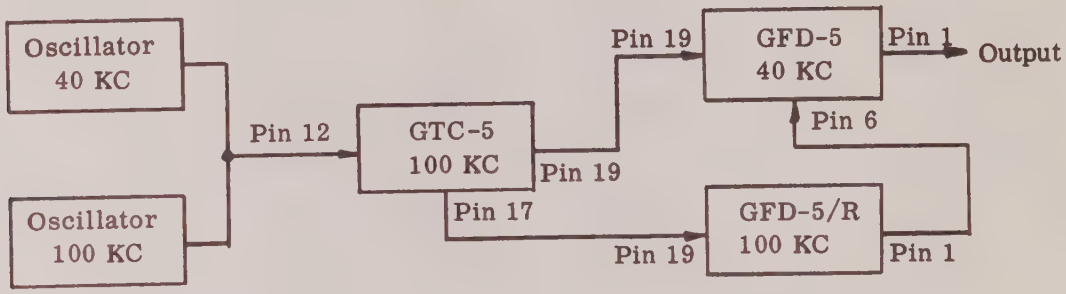
g. Using Table 1-1, ascertain the upper and lower limit for the center frequency used, and tune the oscillator for each bandedge.

h. Orient the deviation meter pointer at upper or lower bandedge.

i. Adjust the GAIN control at the discriminator front panel until the desired bandedge voltage is obtained.

3-7. ADJUSTMENT PROCEDURE.

3-8. In order to accomplish proper tape speed compensation, set up the equipment as shown and proceed as follows:



a. Make proper connections with corresponding ground connections.

b. Ensure 15 minute warmup period for equipment.

c. Zero both data and reference discriminators.

d. Offset 40 KC oscillator by 3%, equals 38.8 KC.

e. Output meter indicator on data discriminator should deflect proportionally.

f. Offset 100 KC oscillator by 3%, equals 97 KC.

g. Data discriminator output indicator should return to zero position.

h. If step g fails to comply, adjust compensation potentiometer on front panel of GFD-5 data discriminator until it zeroes up.

3-9. TURN OFF PROCEDURE. To turn off each GFD-5 discriminator individually, it is necessary to remove the module from the rack. The ON-OFF switch located at the rear of the GMA shuts down all units in the rack.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section covers the preventive procedure and the general maintenance required to ensure proper performance of the equipment. Acceptable performance shall be defined within the limits of the minimum performance tests described herein. Troubleshooting is presented in tabular form and the location of circuit sections and major components are pictorially referenced to permit ease in maintenance.

4-3. TEST EQUIPMENT. Test equipment used for all performance tests and trouble-shooting is listed in Table 4-1.

Table 4-1. List of Test Equipment

Nomenclature	Characteristics
Oscilloscope - Hewlett Packard 130 B or equivalent	Sweep Range: 0.2 u sec/cm to 12.5 sec/cm accurate within 5%. Sensitivity: 1 MV/cm to 125 V/cm accurate within 5%. Bandwidth: DC coupling - dc to 300 KC AC coupling - 2 cps to 300 KC
Oscillator - Hewlett Packard 200 CD or equivalent	5 cps to 600 KC, distortion less than 0.5% below 500 KC. Impedance 600 ohms
A.C. Vacuum Tube Voltmeter Hewlett Packard 400 DR or equivalent	0.1 MV to 300 volts 10 cps to 4 megacycles Input impedance 10 megohms, 15 uuf
Volt- Ohm Meter, Simpson 260 or equivalent	DC: 20,000 ohms per volt AC: 5,000 ohms per volt ±3% of full scale for all d-c voltage and current ranges. ±3% for AC voltages
Crystal Oscillator	0.005% or better
Strip Chart - Rustrak or equivalent	Internal Resistance - 100
DCS - GOV-3 - Voltage Controlled Oscillator	

4-4. SPECIAL TOOLS. Special equipment designed to aid maintenance personnel in maintaining equipment is listed in Table 4-2.

Table 4-2. Special Tools

Nomenclature	Designation
Test Fixture	GTF-2
Extension Cord	GEC-1
Spare Printed Board #1 (Limiter)	
Spare Printed Board #2 (Discriminator)	
Spare GFD-5/TU and GFD-5/TU/L	

4-5. PREVENTIVE MAINTENANCE.

4-6. VISUAL INSPECTION. Slide the tuning filter out of the unit, unfasten the cover screws and remove the aluminum cover from the discriminator. Do not remove the Power Connector Board. Apply leverage against the Elco Pins on printed boards No. 1 and No. 2 with a screwdriver disengaging each one from the Main Connector Board.

4-7. Inspect all subassemblies for physical signs of damage such as broken or leaking components, burned or charred spots on resistors or capacitors and loose or oxidized soldered wires.

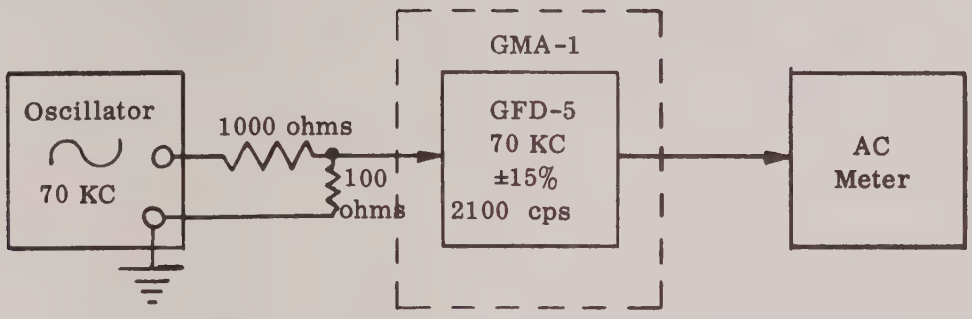
4-8. CLEANING. Since cooling air is constantly flowing through the equipment, the main blower (rack) should be properly filtered. Corners and bottom of the equipment rack should be cleaned periodically with a standard vacuum cleaner. The panel and cover of the discriminator may be cleaned with Carbon Met or any suitable solvent. Interior parts must be air blown.

4-9. LUBRICATION. No lubrication required.

4-10. MINIMUM PERFORMANCE TESTS.

4-11. The tests described herein are the minimum tests required to ensure proper performance If the equipment does not comply with minimum performance, the cause must be determined through maintenance procedure.

4-12. INPUT LEVEL AND OUTPUT NOISE. Set up test equipment with the GFD-5 as shown and proceed with test:



a. Set the oscillator to 70 KC with 10 volts rms at the GFD-5 input.

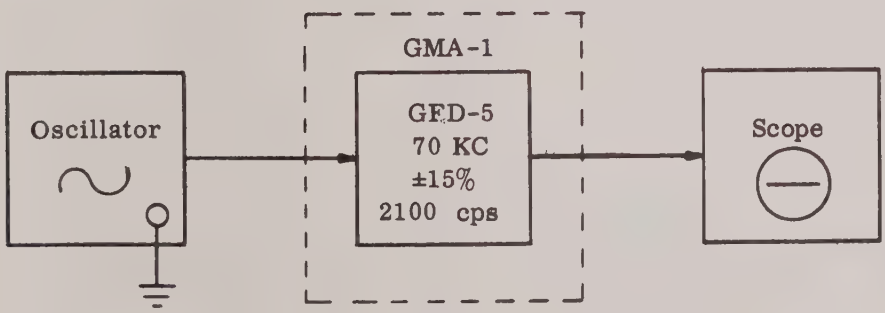
b. After a 15 minute warmup, adjust ZERO control on GFD-5 for zero deviation on output meter and set GAIN control to full clockwise position.

c. AC meter should indicate noise at less than 20 millivolts rms.

d. Decrease the amplitude of the oscillator to 10 millivolts rms at GFD-5 input.

e. The AC meter should still indicate less than 20 millivolts rms.

4-13. OUTPUT VOLTAGE. Set up test equipment with the GFD-5 as shown and proceed with test:



a. Set oscillator for 70 KC at 1 volt rms output and oscilloscope for 100 MV/CM D-C.

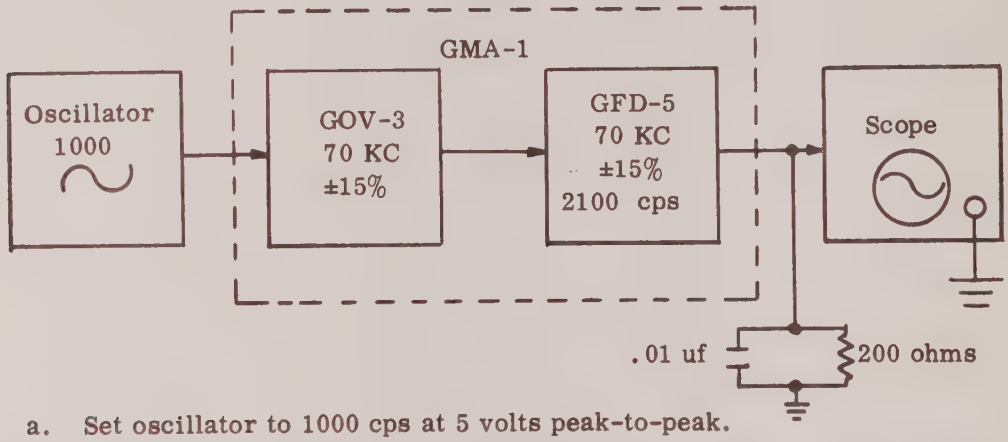
b. Allow 15 minute warmup for GFD-5 and adjust ZERO control for zero volts on oscilloscope.

c. Set oscilloscope for 2 volts/CM D-C and adjust oscillator for 59,500 cycles.

d. Rotate GAIN control at GFD-5 fully clockwise and observe that the oscilloscope indicates greater than -10 volts.

e. Rotate GAIN control at GFD-5 full counter-clockwise and observe that the oscilloscope indicates less than -0.5 volts.

4-14. OUTPUT DRIVING CAPABILITY. Set up test equipment with GFD-5 and GOV-3 as shown and begin test.



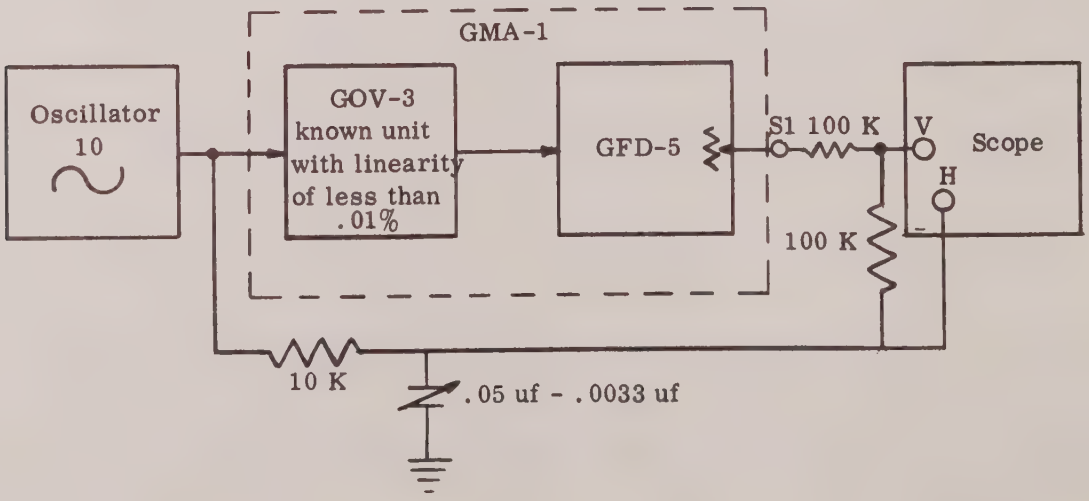
a. Set oscillator to 1000 cps at 5 volts peak-to-peak.

b. With load disconnected, adjust GAIN potentiometer for 20 volts peak-to-peak sinewave on oscilloscope.

c. Alternately switch load (.01 uf ≋ 200Ω) in and out of circuit.

d. Observe that the output sinewave at the oscilloscope is not effected.

4-15. STATIC LINEARITY. Set up test equipment with the GFD-5 and GOV-3 as shown and begin test.



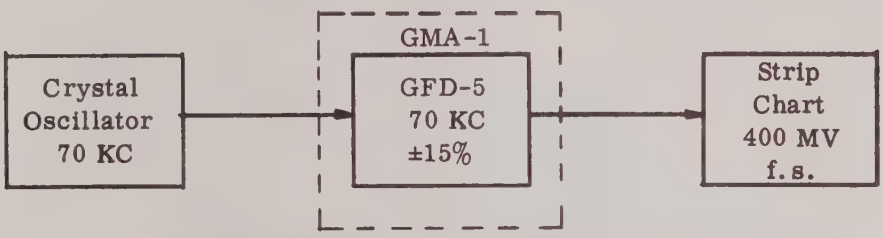
a. Set oscillator to 10 cps at 5 volts peak-to-peak.

b. Adjust the GAIN potentiometer on the GFD-5 until a null in amplitude is indicated on the oscilloscope (horizontal elipse).

c. Adjust the variable capacitor until a null in phase is indicated on the oscilloscope (horizontal straight line). Any component which cannot be nulled out is the resultant non-linearity.

d. Ground S1 and reference the non-linearity at the oscilloscope. Non-linearity is deviation from the best straight line in step c, divided by the vertical peak-to-peak waveform as measured in step d.

4-16. DRIFT. Set up test equipment and GFD-5 as shown and proceed with test.



a. Connect a oscillator to the input of the GFD-5 and set the frequency to band center.

b. Adjust the ZERO control for 0.0 volts on the GFD-5 output.

c. Set the oscillator for bandedge.

d. Rotate the GFD-5 discriminator GAIN control to indicate an output voltage of -10 volts.

e. Remove the H.P. oscillator and connect the 70 KC crystal oscillator output to the GFD-5.

f. If the strip chart has a 100 ohm internal resistance place the 300 ohm resistor in the connector (in series) making the meter 400 MV full scale. Connect meter to the GFD-5 output.

g. Center the strip chart pointer at midscale by adjusting the ZERO control at the GFD-5 and proceed to record drift. The strip chart should indicate drift less than ±0.25% from best straight line of bandwidth for one hour after a 15 minute stabilization period, or less than ±0.5% from best straight line of bandwidth for 15 hours after a 15 minute stabilization period.

NOTE

Strip chart must have 10 major divisions for full scale.

4-17. TROUBLESHOOTING.

4-18. Primarily, troubleshooting consists of isolating a malfunction and resolving the problem within the isolated area. The interchangeable printed circuit boards serve as a valuable troubleshooting tool when used for this purpose, and in many cases lead directly to the malfunction. The discriminator is shown with cover and printed boards removed, and with each section of circuitry called out in Figures4-1, 4-2, 4-3 and 4-4, respectively. Figure 4-5 illustrates the Band Pass Filter.

4-19. Typical waveforms and average voltages are given in Table 4-3 and may be cross referenced to Figure 4-8 by test point number. Troubleshooting is also given in tabular form in Table 4-4 and lists some probable failures which may be helpful in maintenance analysis.

4-20. If data is not being received, observe the behavior of the deviation meter (M1). At higher intelligence frequencies the pointer should center without movement; whereas at low intelligence frequencies the pointer may be seen to oscillate about the center frequency. If the deviation pointer swings to either side and will not center, remove the unit from the rack.

4-21. OVERALL TROUBLESHOOTING.

4-22. To troubleshoot the GFD-5 set up the test equipment as shown in Figure 4-6 and proceed as follows:

a. Apply power to all test sets and the GMA.
b. Remove the cover from the GFD-5 and insert the proper tuning unit for channel to be tested. A medium frequency IRIG channel is suggested.
c. Set the oscilloscope sweep to about 10 mil/sec and the vertical sensitivity to the 10 volt/cm scale (approx.).
d. Turn the amplitude control at the oscillator up until the RMS AC meter reads 100 MV rms.
e. Tune the oscillator to channel center frequency.
f. Place the discriminator on the GTF-2 (see Figure 4-7) test fixture holder and engage the connectors. If no GTF-2 is available, GEC-1 may be used.
g. Vary the oscillator frequency about band center and observe deviation meter pointer and oscilloscope.
h. If there is an indication at the oscilloscope, but the deviation meter does not deflect, check the output jack, meter may be defective.

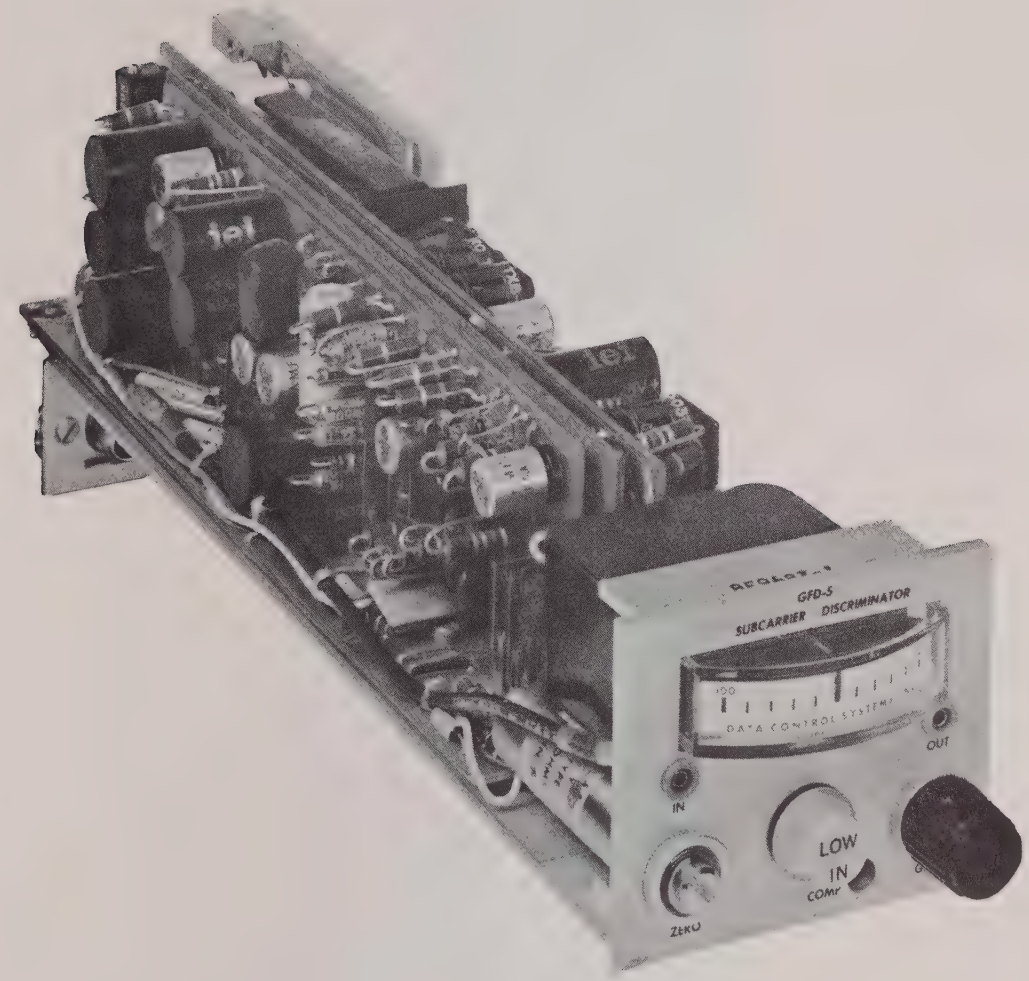


Figure 4-1. Discriminator with Cover and Tuning Unit removed, Model GFD-5

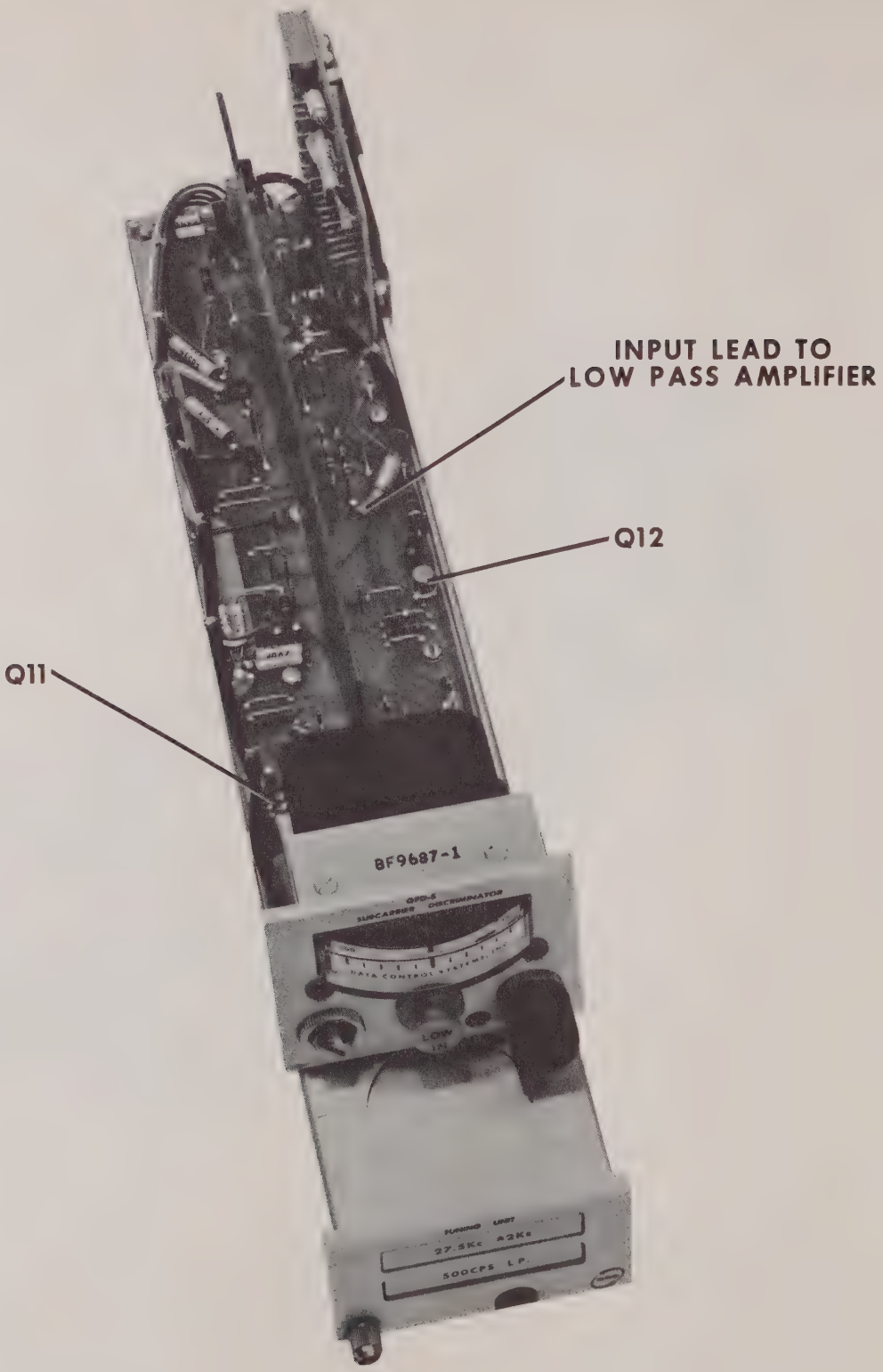


Figure 4-2. Discriminator showing Main and Power Connector Boards, Printed Boards No. 1 and 2 removed, Model GFD-5

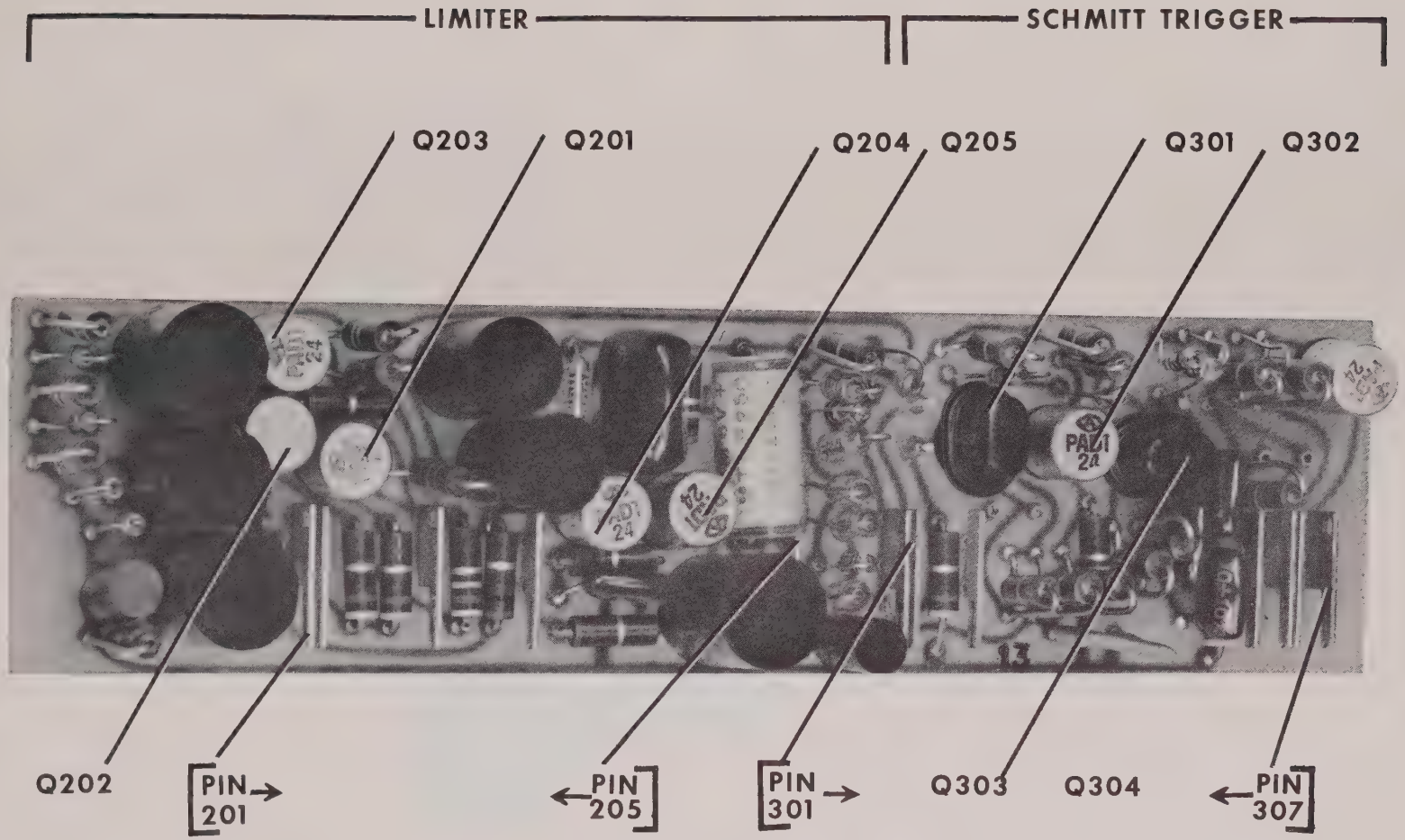


Figure 4-3. Printed Circuit Board No. 1, (Limiter), Model GFD-5

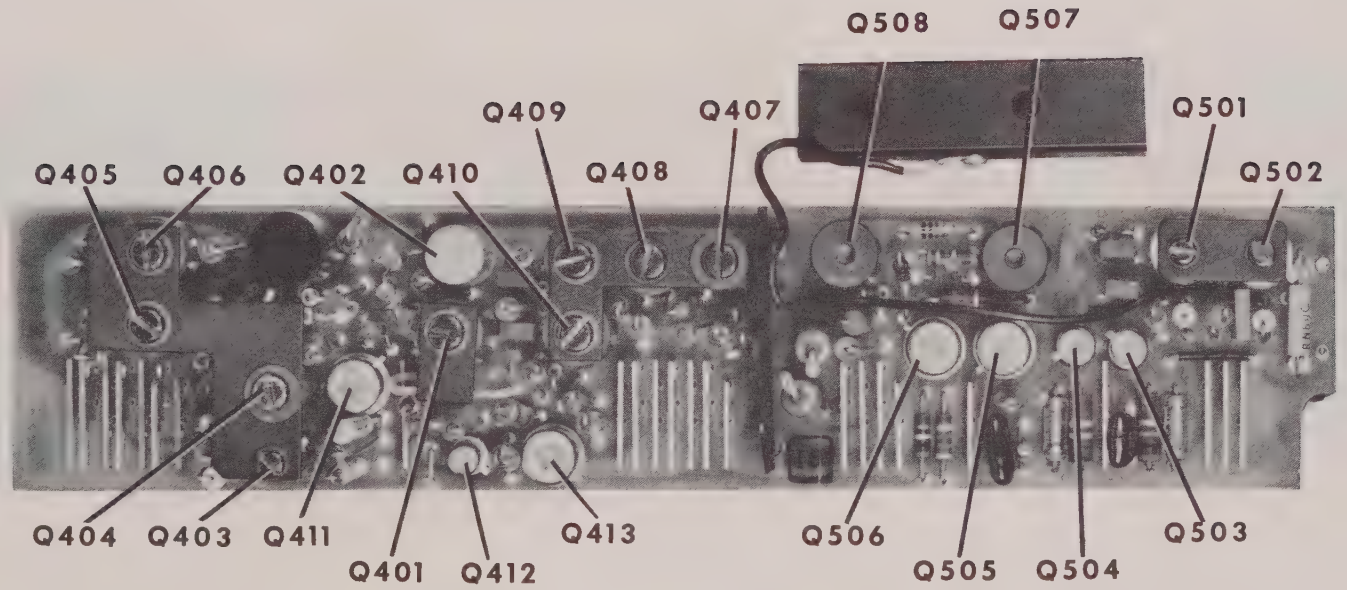


Figure 4-4. Printed Circuit Board No. 2 (Discriminator, Model GFD-5

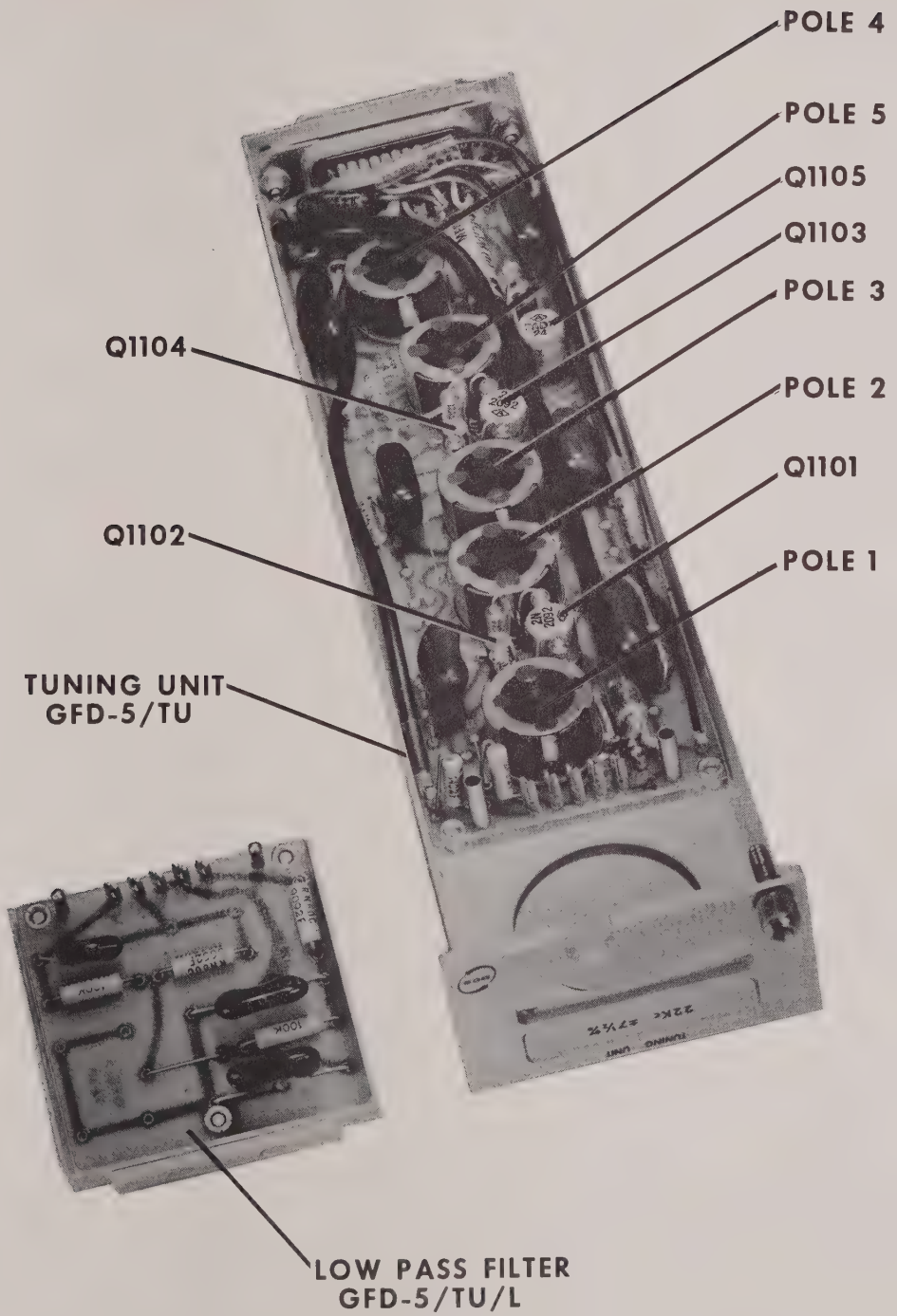


Figure 4-5. Band Pass Filter, Model GFD-5/TU and Low Pass Filter GFD-5/TU/L

Table 4-3. Waveforms

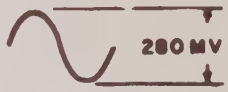
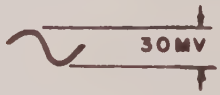
Test Point	Figure Ref. No.	Section	Designation	d-c voltage	Waveform
1	4-5	Band Pass Filter	Pin 19	Zero vdc	
2	4-5	Band Pass Filter	Q1101, Base	Zero vdc	
3	4-3	Ist Limiter	J1	0.6 vdc	
4	4-3	2nd Limiter	Q203, Emitter	- 8 vdc	
5	4-3	2nd Limiter	Q205, Emitter	- 8 vdc	
6	4-3	Schmitt Trigger	Q301, Collector	+ 15 vdc	
7	4-3	Schmitt Trigger	Q303, Collector	+ 24 vdc	
		NOTE: Waveforms taken with 100 mv in at 14.50 kc			

Table 4-3 Waveforms (continued)

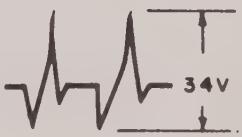
Test Point	Figure Ref. No.	Section	Designation	d-c voltage	Waveform
8	4-3	Schmitt Trigger	Q304, Base	Zero vdc	
9	4-3	Schmitt Trigger	Q304, Collector	- 17 vdc	
10	4-4	Multivibrator	Q404, Collector	- 7 vdc	
11	4-4	Multivibrator	Minus Clamp Junction of CR 405, CR 406	-14.6 vdc	
12	4-4	Multivibrator	Timing Cap. Pin (407)	+ 3.7 vdc	
13	4-4	Multivibrator	Timing Cap. Pin (404)	11 vdc	
14	4-4	Multivibrator	Q411, Emitter	- 6 vdc	
		NOTE: Waveforms taken with 100 mv in at 14.50 kc			

Table 4-3 Waveforms (continued)

Test Point	Figure Ref. No.	Section	Designation	d-c voltage	Waveform
15	4-4	Low Pass Amp.	Q413, Emitter or Pin 410	Zero vdc	
16	4-4	Low Pass Amp.	Q503, Base	+1.6 vdc	
17	4-4	Low Pass Amp.	Q505, Base	0.8 vdc	
18	4-4	Low Pass Amp.	Q505, Collector	+13.8 vdc	
	4-4	Low Pass Amp.	Q506		
19			CR 501 Cathode	+13.2 vdc	
20			CR 501 Anode	-0.74 vdc	
21	4-4	Low Pass Amp.	J2	adjusted to Zero	

NOTE: Waveforms taken with 100 mv in at 14.50 kc

* When channel is modulated, intelligence is discernable at these points.

Table 4-4. Probable Failures

Failure	Cause	Remedy
No output and no reading at all test points	No d-c power	Check pins 3, 4, 5, 7, 8, 9 and 10 on connector board CA-010118. See Table 1-3 and Figure 2-1
Excessive noise at output	Elco pins bent or not properly engaged in GMA connector	Check pins 1, 2, 19 and 20
Indicator Lamp DS-1 stays on although GFD-5 operates within proper range.	Peak detector C15, CR11, R15 or Bias R17 open. Q11 shorted	Replace components
No output. Phenolic burned at base of R518 and R520	Q507, Q508 shorted	Replace Q507 and Q508 after checking resistors
No reading at test point 13	Q411, Q412 or Q413 if indication at test point 10 correct	Replace transistor and associated components if necessary
Multivibrator will not operate. No square wave at test point 10. Correct waveform at test point 9	CR405, CR406, CR407 or CR408 shorted. C1401, Q403, Q404, Q405 or Q406 shorted or open. CR412 or C404 shorted	Check diodes and replace if necessary. Check components and replace.
Incorrect or no reading at test point 8	Q301 or Q303, CR305, CR304 or differentiator circuit open or shorted	Check test points 6 & 7, if reading is correct, check the latter and Q304
No reading at test point 5	Q204 or Q504 open or shorted if test point 4 is o.k.	Replace transistor
No reading at test point 2	Q202 or Q203 if reading at J1 correct	Replace after checking associated components
No reading at J1	GFD-5/TU Plug-in not properly seated. No input signal	Check plug-in and input connections

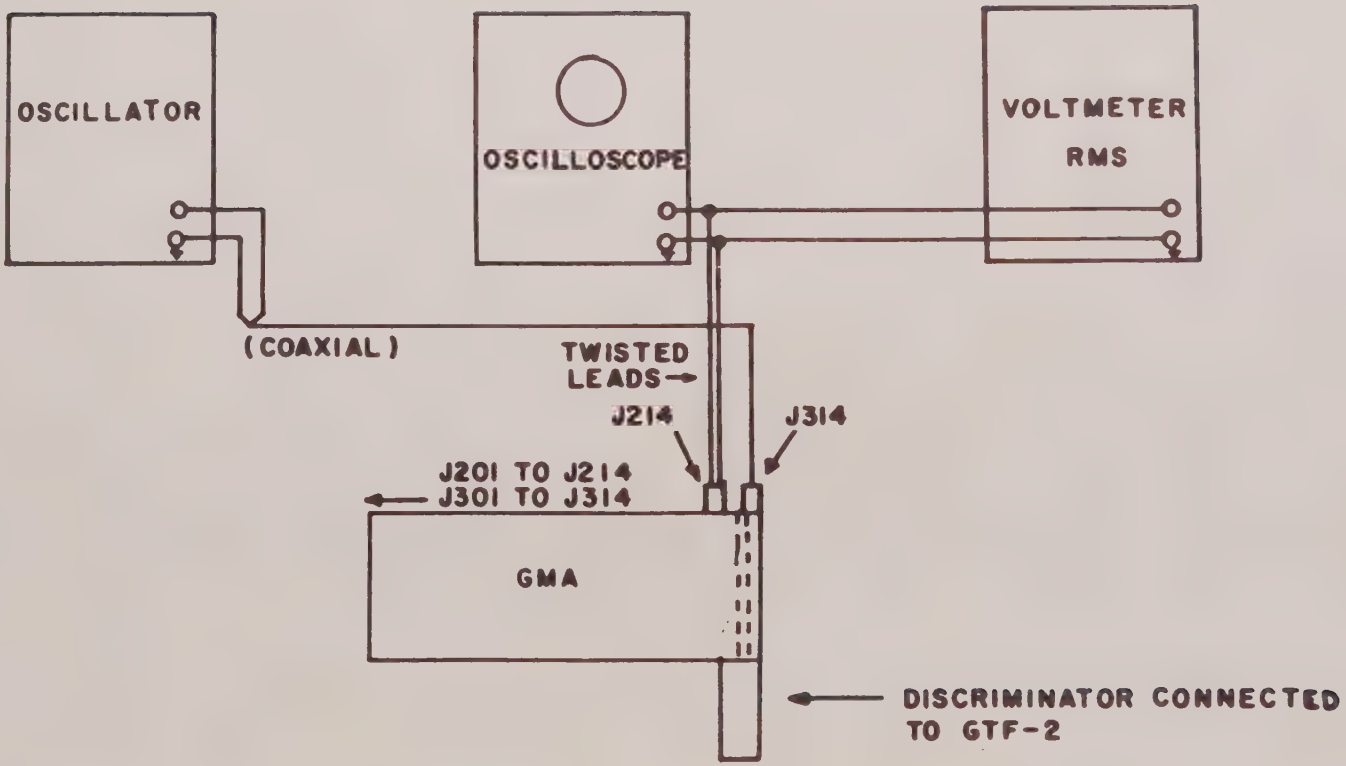


Figure 4-6. Typical Bench Test Set Up

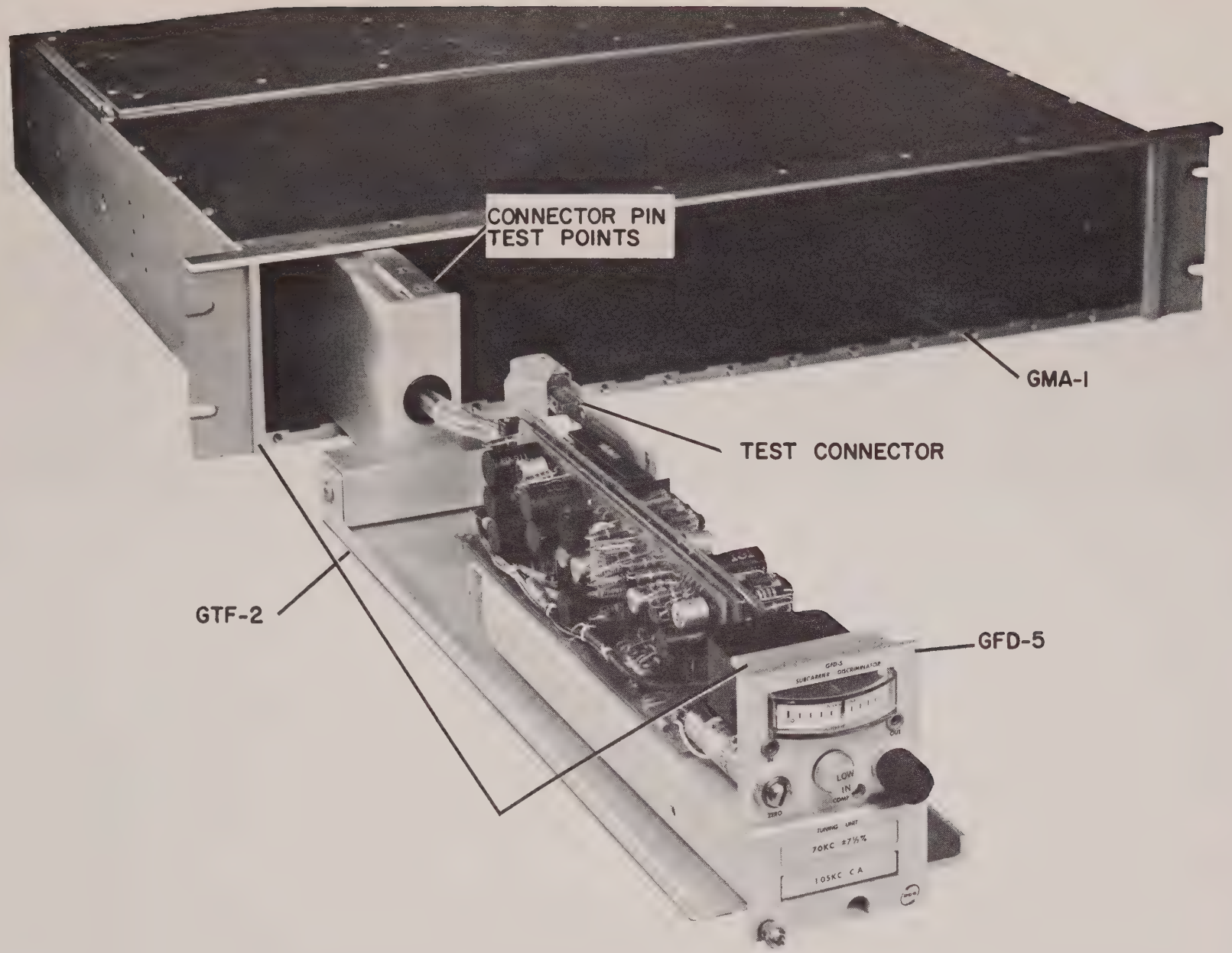


Figure 4-7. GTF-2 and GFD-5 Set Up for Testing

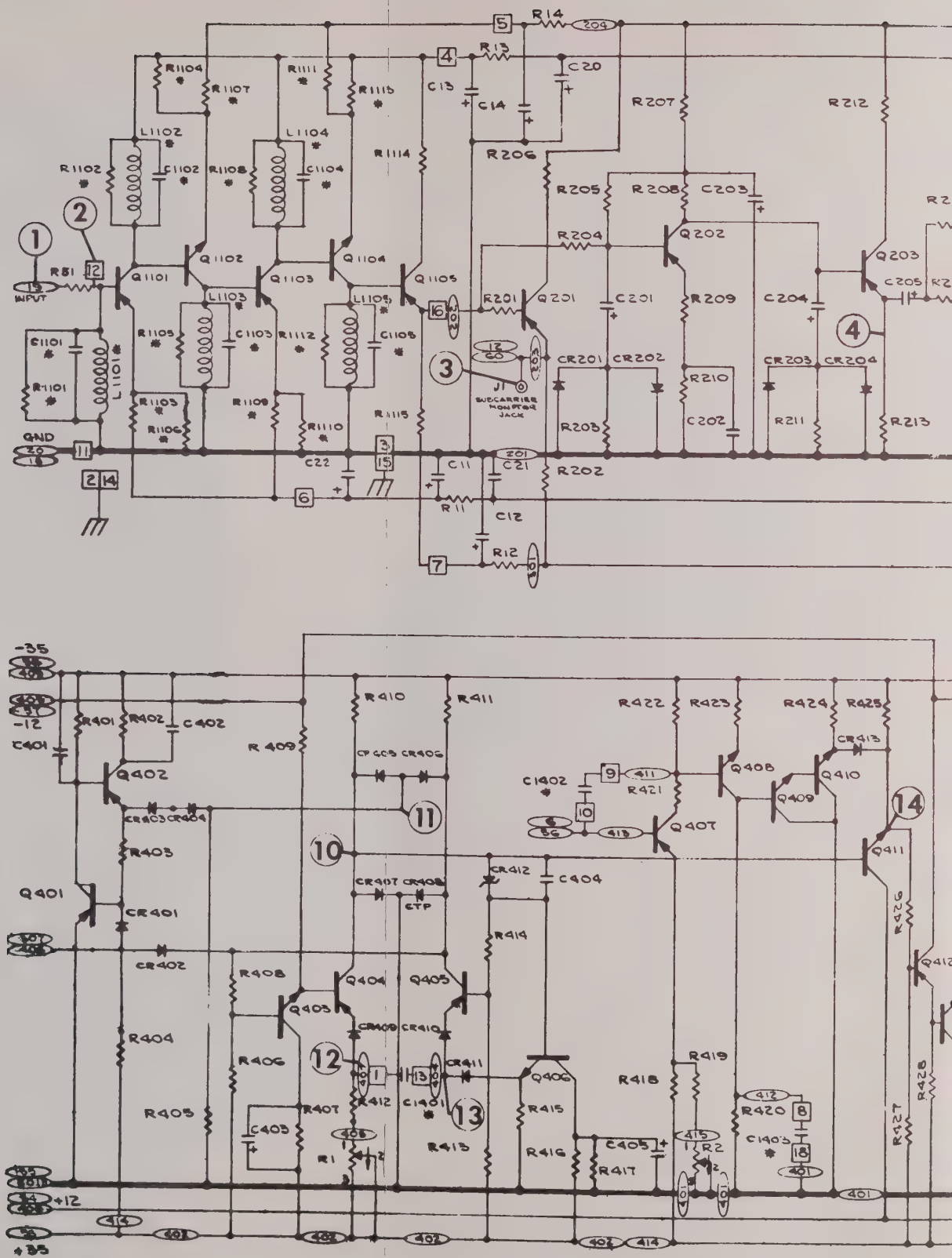
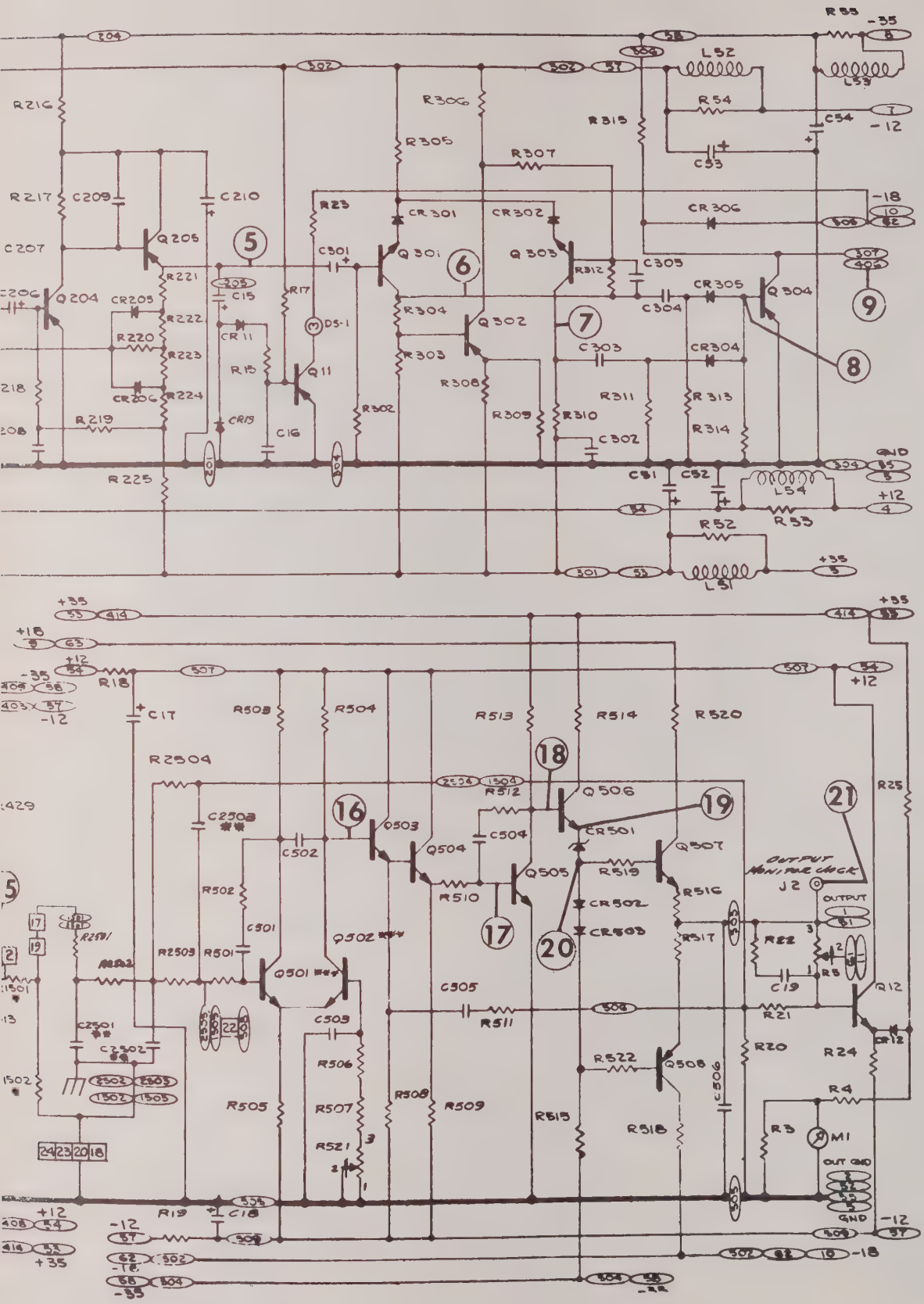


Figure 4-8. Test Points, Model GFD-5


R55
-35
L52
L53
R54
C54
-12
C53
R216
R306
R305
R307
R315
R217
C209
C210
R23
CR301
CR302
CR306
-18
C207
Q205
5
C301
Q301
6
Q303
C305
Q204
CR205
R221
C15
R17
DS-1
R312
CR305
Q304
9
R304
Q302
7
C304
R222
R220
R223
CR11
R15
Q11
C303
CR304
8
R303
R308
R311
R313
R224
CR206
R219
CR13
C16
R302
R309
R310
R314
C302
R225
C51
C52
GND
L54
+12
R52
R53
L51
+35
+35
+18
+12
-35
-12
R18
C17
R508
R504
R513
R514
R520
R2504
18
Q506
R25
C2508
16
Q503
19
21
C502
C504
CR501
Q504
Q505
Q507
OUTPUT MONITOR CHECK
J2
OUTPUT
R502
R519
R510
17
20
CR502
CR503
R516
R517
R22
C501
R2503
R501
Q502
Q501
C505
C19
R5
Q12
R21
C2501
C2502
C503
R511
R522
Q508
R20
R24
R506
R505
R507
R508
R509
R515
R518
C506
R4
R3
M1
R521
24 23 20 18
OUT GND
GND
+12
R19
C18
-12
-12
+35
-18
-35

i. If the pointer will not center, check waveform at test point 15 (Q413 emitter). Refer to typical waveforms shown in Table 4-3. If waveform is correct, malfunction is in either the Low Pass Amplifier section or Low Pass plug-in unit. Results can be further verified by inserting the spare Printed Circuit Board No. 2 into the unit. If no spare is available, use a card from a working unit.

NOTE

Be sure to turn GMA power off before removing cards.

j. If waveform at test point 15 is incorrect, check waveform at test point 9 (pin 307 or pin 406). If waveform is correct, malfunction is in Discriminator section. Results can again be verified by inserting the Spare Printed Circuit Board No. 2 into the unit and rechecking test point 15.

k. If waveform at test point 9 is incorrect, check waveform at test point 5 (Q205 collector). If waveform is correct, malfunction is in the Schmitt Trigger Section. Results can be verified by inserting spare Printed Circuit Board No. 1 into the unit.

l. If the waveform at test point 5 is incorrect, check waveform at test point 3 (subcarrier monitor). If this waveform is correct, malfunction is doe to the Limiter section. Results in this step can be verified by inserting spare Printed Circuit Board No. 1 into the unit and rechecking waveform at test point 5.

m. If the waveform at test point 3 is incorrect, check waveform at test points 1 and 2. If these waveforms are correct, try a different channel selector.

n. If the above procedure described does not reveal the malfunction, test spare Printed Circuit Boards in a unit that is known to be good.

4-23. CIRCUIT BOARD TROUBLESHOOTING. Location of primary components is shown in Figures 4-3 and 4-4.

4-24. Remove the printed circuit board in which the suspected malfunction exists and proceed as follows:

a. Obtain a voltmeter (Simpson 260) and adjust the meter for continuity check. Set the resistance at R X 100.

b. Turn the card over so the circuitry may be observed and locate the emitter-base-collector terminals of each transistor. (A bright light beneath the card will make the outline of each transistor easier to identify, permitting rapid location of each component.

c. Place the test probes between emitter and base; then reverse the position of the probes. One of these positions should indicate forward bias on the meter.

d. Continue checking between base-collector, base-emitter and emitter-collector.

e. If the voltmeter does not deflect in either position, the junction is probably open. Replace component.

f. If both probe positions cause the meter to indicate the same resistance the junction is probably shorted. Replace component.

g. Before replacing a transistor examine associated components with the meter to determine if any change in value may have caused damage to the transistor. Component values are listed in Drawings TA-010052 and GA-010697.

h. Examine all Elco pins to ensure that none have been bent or spread open.

4-25. NOISE. Excessive noise problems may be partially isolated by removing the input lead to the Low Pass Amplifier (see Figure 4-2). If noise decreases with the lead grounded the trouble is ahead of the Low Pass Amplifier. While checking the discriminator suspect Zener CR412 if output noise is above 100 millivolts.

ERRATA

ALL REPLACEMENT PARTS LISTS

All resistors that are Texas Instrument, CG1/4, 1/4W, 1% are interchangeable with Electra, MF5C-D, 1/4W, 1%.

Table 4-5. Replacement Parts List

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk **	Remarks
1	M1	Meter	BD-009702	International	1	1	1	Used on Front Panel
2		Lamp	344	G.E.	1		20	" " " "
3	R5	Potentiometer	BD-008497,	I.R.C.	1	1	2	" " " "
			20%, 10 K					
4	R1	Potentiometer	BD-011414,	I.R.C.	1	1	2	" " " "
			10%, 1 K					
5	R2	Potentiometer	30675-1-202, 2K	Bourns	1	1		" " " "
6	R3	Resistor MS35350	MF5C-D, 1%,	Electra	1	.5		" " " "
			1/4W, 309ohms					
7	R4	Resistor MS35350	MF5C-D, 1%,	Electra	1	.5		" " " "
			1/4W, 1.05Kohms					
8		Discriminator Card	GA-010697	DCS	1		2	
9	Q406	Transistor	MM487	Motorola	9	1		Used in Item #8
10	Q408	Transistor	MM487	Motorola		1		" " " "
11	Q409	Transistor	MM487	Motorola		1		" " " "
12	Q410	Transistor	MM487	Motorola		1		" " " "
13	Q411	Transistor	MM487	Motorola		1		" " " "
14	Q413	Transistor	MM487	Motorola		1		" " " "
15	Q505	Transistor	MM487	Motorola		1		" " " "
16	Q506	Transistor	MM487	Motorola		1		" " " "
17	Q507	Transistor	MM487	Motorola		1		" " " "
18	Q501	Transistor	2N929	Texas Instr.	2	1		" " " "
19	Q502	Transistor	2N929	Texas Instr.		1		" " " "
20	Q503	Transistor	SM1036A	Texas Instr.	2	1		" " " "
21	Q504	Transistor	SM1036A	Texas Instr.		1		" " " "
22	Q412	Transistor	MM999	Motorola	1	1		" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

**Qty. per 14 units for one year

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
23	Q401	Transistor	SO3	Texas Instr.	3	1		Used in Item #8
24	Q402	Transistor	SO3	Texas Instr.		1		" " " "
25	Q405	Transistor	PADT-24	Amperex		1		" " " "
26	Q403	Transistor	2N703	Texas Instr.	1	1		" " " "
27	Q404	Transistor	2N2189	Texas Instr.	2	1		" " " "
28	Q407	Transistor	2N2189	Texas Instr.		1		" " " "
29	R521	Potentiometer	3067P-1-203	Bourns	1	1		" " " "
			20K					
30	R422	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 2.87 K					
31	R424	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 26.1 K					
32	R405	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 9.09 K					
33	R429	Resistor MS35350	CG, 1/4W,	Texas Instr.	3	.2		" " " "
			1%, 10 K					
34	R421	Resistor MS35350	CG, 1/4W,	Texas Instr.	2	.2		" " " "
			1%, 1.47 K					
35	R419	Resistor MS35350	CG, 1/4W,	Texas Instr.	2	.2		" " " "
			1%, 4.22 K					
36	R425	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 14.7 K					
37	R414	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 100 ohms					
38	R418	Resistor MS35043	C20, 1/2W,	Corning Glass	1	.2		" " " "
			2%, 6.2 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
39	R420	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		Used in Item #8
			1%, 51.1 K					
40	R411	Resistor MS35350	CG, 1/4W,	Texas Instr.		.2		" " " "
			1%, 10 K					
41	R413	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 21.5 K					
42	R409	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 42.2 K					
43	R423	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 68.1 K					
44	R407	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 34.8 K					
45	R402	Resistor MS35350	CG, 1/4W,	Texas Instr.		.2		" " " "
			1%, 1.47 K					
46	R403	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1.78 K					
47	R404	Resistor MS35043	C20, 1/2W,	Corning Glass		.2		" " " "
			2%, 4.3 K					
48	R410	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 8.25 K					
49	R503	Resistor MS35350	CG, 1/4W,	Texas Instr.	2	.2		" " " "
			1%, 100 K					
50	R428	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 34.8 K					
51	R426	Resistor MS35350	CG, 1/4W,	Texas Instr.		.2		" " " "
			1%, 10 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
52	R427	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		Used in Item #8
			1%, 54.9 K					
53	R504	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1 m ohms					
54	R509	Resistor MS35350	CG, 1/4W,	Texas Instr.		.2		" " " "
			1%, 100 K					
55	R415	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 47 K					
56	R416	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 2.7 K					
57	R417	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 33 K					
58	R401	Resistor MS35043	EB, 1/2W,	Allen Bradley	3	.2		" " " "
			10%, 22 K					
59	R508	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 10 M					
60	R511	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 22 K					
61	R513	Resistor MS35350	CB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 10 K					
62	R514	Resistor MS35350	CB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 470 ohms					
63	R515	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 3.9 K					
64	R516	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		" " " "
			10%, 2.7 ohms					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty Spk	Remarks
65	R517	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		Used in Item #8
			10%, 2.7 ohms					
66	R519	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 470 ohms					
67	R502	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 12 K					
68	R510	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 470ohms					
69	R512	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 22 K					
70	R522	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 100ohms					
71	R518	Resistor	P1, 1%, 47ohms	Mepco	2	.5		" " " "
72	R520	Resistor	P1, 1%, 47ohms	Mepco		.5		" " " "
73	R412	Resistor	60T2, 1%,	Ward Leonard	1	.5		" " " "
			3.92 K					
74	R406	Resistor	60T2, 1%,	Ward Leonard	1	.5		" " " "
			28.7 K					
75	R408	Resistor	60T2, 1%,	Ward Leonard	1	.5		" " " "
			16.9 K					
76	R501	Resistor	60T2, 1%,	Ward Leonard	1	.5		" " " "
			10 K					
77	CR402	Diode	CTP700A	Clevite	9	1		" " " "
78	CR403	Diode	CTP700A	Clevite		1		" " " "
79	CR404	Diode	CTP700A	Clevite		1		" " " "
80	CR405	Diode	CTP700A	Clevite		1		" " " "
81	CR406	Diode	CTP700A	Clevite		1		" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
82	CR503	Diode	CTP700A	Clevite		1		Used in Item #8
83	CR408	Diode	CTP700A	Clevite		1		" " " "
84	CR413	Diode	CTP700A	Clevite		1		" " " "
86	CR407	Diode	CGD1032	Clevite	3	1		" " " "
87	CR409	Diode	CGD1032	Clevite		1		" " " "
88	CR411	Diode	CGD1032	Clevite		1		" " " "
89	CR412	Diode	IN768A	Cont. Devices	1	1		" " " "
90	CR501	Diode	IN766 -1	Transitron	1	1		" " " "
91	CR410	Diode	28J2	G.E.	2	1		" " " "
92	CR502	Diode	28J2	G.E.		1		" " " "
93	CR401	Diode	IN3067	Cont. Devices	1	1		" " " "
94	C505	Capacitor	DM10, 100V,	Durmica	1	.1		" " " "
			47 uuf					
95	C402	Capacitor	VK20, 200V,	Vitramon	1	.5		" " " "
			1000 uuf					
96	C403	Capacitor	62F204, 25V,	G.E.	1	.5		" " " "
			10 uf					
97	C404	Capacitor	11901, .01 uf	Mucon	1	.5		" " " "
98	C405	Capacitor	109D226X0100	Sprague	1	.5		" " " "
			F2,100V,22uf					
99	C504	Capacitor	DM15, 100V,	Durmica	1	.1		" " " "
			22 uuf					
100	C401	Capacitor	VK20, 200V,	Vitramon	2	.5		" " " "
			47 uuf					
101	C501	Capacitor	VK20, 200V,	Vitramon		.5		" " " "
			47 uuf					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk **	Remarks
102	C502	Capacitor	VK20, 200V,	Vitramon	1	.5		Used in Item #8
			100 uuf					
103	C503	Capacitor	VK30, 200V,	Vitramon	1	.5		" " " "
			.01 uf					
104	C506	Capacitor	VK30, 200V,	Vitramon	1	.5		" " " "
			6800 uuf					
105		Limiter Card	TA-010052	DCS	1		2	
106	Q201	Transistor	PADT-24	Amperex	7	1		Used in Item #105
107	Q202	Transistor	PADT-24	Amperex		1		" " " "
108	Q203	Transistor	PADT-24	Amperex		1		" " " "
109	Q204	Transistor	PADT-24	Amperex		1		" " " "
110	Q205	Transistor	PADT-24	Amperex		1		" " " "
111	Q302	Transistor	PADT-24	Amperex		1		" " " "
112	Q304	Transistor	PADT-24	Amperex		1		" " " "
113	Q301	Transistor	2N2501	G.E.	2	1		" " " "
114	Q303	Transistor	2N2501	G.E.		1		" " " "
115	CR205	Diode	28J2	G.E.	2	1		" " " "
116	CR206	Diode	28J2	G.E.		1		" " " "
117	CR201	Diode	CTP700A	Clevite	9	1		" " " "
118	CR202	Diode	CTP700A	Clevite		1		" " " "
119	CR203	Diode	CTP700A	Clevite		1		" " " "
120	CR204	Diode	CTP700A	Clevite		1		" " " "
121	CR301	Diode	CTP700A	Clevite		1		" " " "
122	CR302	Diode	CTP700A	Clevite		1		" " " "
123	CR304	Diode	CTP700A	Clevite		1		" " " "
124	CR305	Diode	CTP700A	Clevite		1		" " " "
125	CR306	Diode	CTP700A	Clevite		1		" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

**Qty. per 14 units for one year

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
127	R201	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		Used in Item #105
			10%, 4.7 K					
128	R202	Resistor MS35043	EB, 1/2W,	Allen Bradley	3	.2		" " " "
			10%,47 K					
129	R203	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 470 K					
130	R204	Resistor MS35350	CB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 4.7 K					
131	R205	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 47 K					
132	R206	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		" " " "
			10%, 27 K					
133	R207	Resistor MS35350	CB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 1 K					
134	R208	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 8.2 K					
135	R209	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 150 ohms					
136	R210	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 680 ohms					
137	R211	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 390 K					
138	R212	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 1 K					
139	R213	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 4.7 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
140	R215	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		Used in Item #105
			10%, 506 ohms					
141	R216	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		" " " "
			10%, 1.5 K					
142	R217	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 22 K					
143	R218	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 10 K					
144	R219	Resistor MS35043	EB, 1/2W,	Allen Bradley	3	.2		" " " "
			10%, 2.2 K					
145	R302	Resistor MS35350	CB, 1/4W,	Allen Bradley	2	.2		" " " "
			10%, 47 K					
146	R303	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 2.2 K					
147	R304	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 2.7 K					
148	R305	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 2.2 K					
149	R306	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		" " " "
			10%, 5.6 K					
150	R307	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 5.6 K					
151	R308	Resistor MS35043	EB, 1/2W,	Allen Bradley	2	.2		" " " "
			10%, 12 K					
152	R309	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 120 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
153	R310	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		Used in Item #105
			10%, 3.3 K					
154	R311	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 47 K					
155	R312	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 27 K					
156	R313	Resistor MS35350	CB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 47 K					
157	R314	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 1.5 K					
158	R315	Resistor MS35043	EB, 1/2W,	Allen Bradley		.2		" " " "
			10%, 12 K					
159	R214	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 909 ohms					
160	R220	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 511 K					
161	R221	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1 K					
162	R222	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1 K					
163	R223	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1 K					
164	R224	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 1.47 K					
165	R225	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 17.8 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty Item	Spares Recm*	Qty Spk	Remarks
166	C201	Capacitor	APS104, 15V,	I.E.I.	1	.5		Used in Item #105
			50 uf					
167	C202	Capacitor	APS012, 6 V,	I.E.I.	1	.5		" " " "
			25 uf					
168	C203	Capacitor	APS147, 50V,	I.E.I.	2	.5		" " " "
			20 uf					
169	C204	Capacitor	APS145, 20V,	I.E.I.	1	.5		" " " "
			60 uf					
170	C205	Capacitor	APS106, 25V,	I.E.I.	2	.5		" " " "
			30 uf					
171	C206	Capacitor	APS106, 25V,	I.E.I.		.5		" " " "
			30 uf					
172	C210	Capacitor	APS147, 50V,	I.E.I.		.5		" " " "
			20 uf					
173	C301	Capacitor	APS015, 20V,	I.E.I.	1	.5		" " " "
			10 uf					
174	C207	Capacitor	VK30, 4700uuf	Vitramon	1	.5		" " " "
175	C209	Capacitor	DM15, 100V,	Durmica	1	.1		" " " "
			5 uuf					
176	C303	Capacitor	DM15, 100V,	Durmica	2	.1		" " " "
			10 uuf					
177	C304	Capacitor	DM15, 100V,	Durmica		.1		" " " "
			10 uuf					
178	C305	Capacitor	DM15, 100V,	Durmica	1	.1		" " " "
			22 uuf					
179	C208	Capacitor	SMT, 6V, 25 uf	Illinois	1	5		" " " "
180	C302	Capacitor	11901, .01 uf	Mucon	1	1		" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5B Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk**	Remarks
181		Mother Card	TA-010036	DCS	1		1	
182	C11	Capacitor	62F202, 15V,	G.E.	4	.5		Used in Item #181
			20 uf					
183	C12	Capacitor	62F305, 50V,	G.E.	2	.5		" " " "
			25 uf					
184	C13	Capacitor	62F202, 15V,	G.E.		.5		" " " "
			20 uf					
185	C14	Capacitor	62F305, 50V,	G.E.		.5		" " " "
			25 uf					
186	C15	Capacitor	62F102, 15V,	G.E.	3	.5		" " " "
			8 uf					
187	C17	Capacitor	62F102, 15V,	G.E.		.5		" " " "
			8 uf					
188	C18	Capacitor	62F102, 15V,	G.E.		.5		" " " "
			8 uf					
189	C22	Capacitor	62F202, 30V,	G.E.		.5		" " " "
			100 uf					
190	C21	Capacitor	62F202, 15V,	G.E.		.5		" " " "
			20 uf					
191	C19	Capacitor	DM10, 100V,	Durmica	1	.1		" " " "
			100 uuf					
192	C16	Capacitor	V84B, 150V,	Aerovox	1	.5		" " " "
			.1 uf					
193	CR12	Diode	CTP2344	Clevite	1	1	4	" " " "
194	Q12	Transistor	SM1036A	Texas Instr.	1	1	4	" " " "
195	Q11	Transistor	2N2189	Texas Instr.	1	1	6	" " " "
196	CR11	Diode	CTP700A	Clevite	2	1	6	" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

**Qty. per 14 units for one year

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 **Nomenclature:** Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Snk	Remarks
197	R17	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		Used in Item #181
			1%, 34.8 K					
198	R22	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		" " " "
			10%, 2.7 K					
199	R11	Resistor MS35350	EB, 1/4W,	Allen Bradley	2	.2		" " " "
			10%, 470ohms					
200	R23	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 470ohms					
201	R24	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 5.6 K					
202	R12	Resistor MS35350	EB, 1/4W,	Allen Bradley	4	.2		" " " "
			10%, 1 K					
203	R13	Resistor MS35350	EB, 1/4W,	Allen Bradley	1	.2		" " " "
			10%, 220ohms					
204	R14	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 1 K					
205	R18	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 1 K					
206	R19	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 1 K					
207	R20	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 76.8 K					
208	R21	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 287 ohms					
209	R15	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			1%, 10.5 K					
210	CR13	Diode	CTP700A	Clevite		1		" " " "

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk **	Remarks
211		Father Card	BA-010118	D.C.S.	1		2	
212	R52	Resistor MS35350	EB, 1/4W,	Allen Bradley	4	.2		Used in Item #211
			10%, 56 ohms					
213	R54	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 56 ohms					
214	R53	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 56 ohms					
215	R55	Resistor MS35350	EB, 1/4W,	Allen Bradley		.2		" " " "
			10%, 56 ohms					
216	L51	Coil	WEE 120,120 uh	Nytronics, Inc.	2	.5		" " " "
217	L53	Coil	WEE 120,120 uh	Nytronics, Inc.		.5		" " " "
218	C51	Capacitor	62F305, 50V,	G.E.	2	.5		" " " "
			25 uf					
219	C54	Capacitor	62F305, 50V,	G.E.		.5		" " " "
			25 uf					
220	C52	Capacitor	62F102, 15V,	G.E.	2	.5		" " " "
			8 uf					
221	C53	Capacitor	62F102, 15V,	G.E.		.5		" " " "
			8 uf					
222	L52	Choke	Ring Ding	Delevan	2	.5		" " " "
			2500-28,1mh					
223	L54	Choke	Ring Ding	Delevan		.5		" " " "
			2500-28,1mh					
224	R51	Resistor MS35350	CG, 1/4W,	Texas Instr.	1	.2		" " " "
			100 K, 1%					
225	Q508	Transistor	2N1131	Fairchild	1	1		Used in Item #8

*Spares for 1 unit per 10,000 hrs. con't. operation **Qty. per 14 units for one year

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
226		Band Pass A'ssy.	TA-010035	DCS	1			
227	Q1101	Transistor	PADT24	Amperex	3	1		Used in Item #226
228	Q1103	Transistor	PADT24	Amperex		1		" " " "
229	Q1105	Transistor	PADT24	Amperex		1		" " " "
230	Q1102	Transistor	2N2218	Motorola	2	1		" " " "
231	Q1104	Transistor	2N2218	Motorola		1		" " " "
232	C20	Capacitor	62F202,15V,	G.E.	1	.5		Used in Item #181
			20 uf					
233	R25	Resistor MS35350	MF5C-D,1%,	Electra	1	.5		" " " "
			1/4W, F.A.					
234	R505	Resistor MS35350	MF5C-D,1%,	Electra	1	.5		Used in Item #8
			1/4W, F.A.					
235	R506	Resistor	WL-60T2,1%,	Ward Leonard	2	.5		" " " "
			F.A.					
236	R507	Resistor	WL-60T2,1%,	Ward Leonard		.5		" " " "
			F.A.					
237		L.P.F. Card Ass'y. Rauch	BA-009896	DCS	1			
238	R2501	Resistor	WL-60T2,1%,	Ward Leonard	1	.5		Used in Item #237
			90.9 K					
239	R2502	Resistor	WL-60T2,1%,	Ward Leonard	2	.5		" " " "
			100 K					
240	R2503	Resistor	WL-60T2,1%,	Ward Leonard		.5		" " " "
			100 K					
241	R2504	Resistor	WL-60T2,1%,	Ward Leonard	1	.5		" " " "
			66.5 K					
242	R1114	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		Used in Item #226
			10%, 1 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-5. Replacement Parts List (continued)

DCS Model GFD-5 Nomenclature: Subcarrier Discriminator

Item No.	Symbol No.	Part Description	Manufacturer's Part Number	Manufacturer's Name	Qty/ Item	Spares Recm*	Qty/ Spk	Remarks
243	R1115	Resistor MS35043	EB, 1/2W,	Allen Bradley	1	.2		Used in Item #226
			10%, 12 K					

*Spares for 1 unit per 10,000 hrs. con't. operation

Table 4-6. Recommended Spare Parts List, GFD-5

Item No.	Part Number	Description	Qty./14 Units
1		Lamp, G.E. 344	20
2	R1	Pot., IRC, 10%, 1K, BD-011414	2
3	R5	Pot., IRC, 20%, 10K, BD-008497	2
4	Q11	Transistor, Texas Instr. 2N2189	6
5	Q12	Transistor, SM1036A or 2N929	4
6	CR11, CR13	Diode, Clevite CTP700A	6
7	CR12	Diode, CTP2344	4
8	M1	Meter, BD-009702, International	1
9	TA-010052	Limiter Board Assembly	2
10	BA-010118	Father Board Assembly	2
11	GA-010697	Discriminator Board Ass'y.	2
12	TA-010036 CD-008847	Chassis Assembly	1

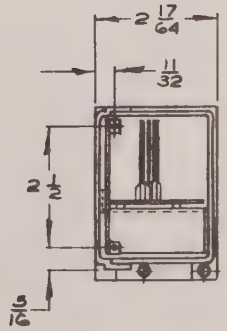
SECTION V

DRAWINGS

5-1. GENERAL. The drawings listed in this section are furnished to supplement the information given in the text.

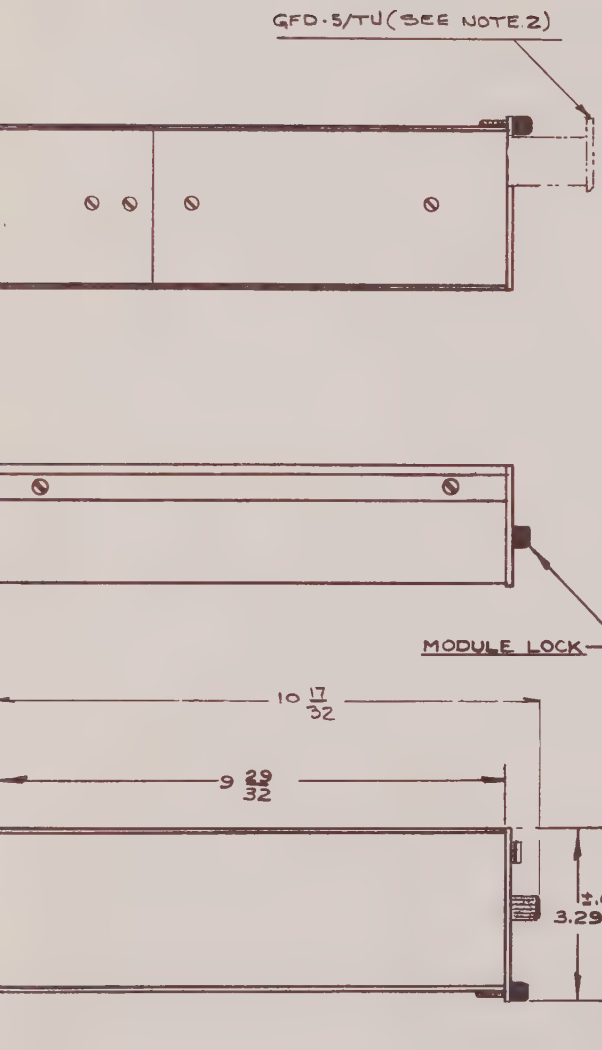
CO-010155	Outline Drawing, GFD-5
DW-010696	Schematic, GFD-5, Style B
TA-010035	Band Pass Assembly, GFD-5
BA-009896	Low Pass Filter - Rauch
BA-010105	Low Pass Filter (5 pole RLC)
TA-010036	Main Connector Board (Mother)
TA-010052	Limiter Assembly
GA-010697	Discriminator Assembly
CA-010118	Power Connector Board (Father)

REV.	ZONE	DESCRIPTION	DATE	DWN	CHK.	APP.
B	—	CA-2480-ADDED TOL. TO 3.29 DIM	9/23/69	[illegible]	. .	CF
C	—	CA-1307-2 -CHG'D. PIN CALLOUTS	5/19/75	[illegible]	WY	WY



REF	DESCRIPTION	QTY

PIN NO.	TABULATION, PIN CONNECTIONS DESCRIPTION
1	Signal Lead OUTPUT
2	Signal Lead GROUND
3	+ 35 Volts D.C.
4	+ 12 Volts D.C.
5	Ground
6	W&F INPUT
7	- 12 Volts D.C.
8	- 35 Volts D.C.
9	+ 18 Volts Unregulated
10	- 18 Volts Unregulated
11	REFERENCE GAIN
12	SUBCARRIER MONITOR
13	GROUND TO PIN 5 (INTERNAL)
14	GROUND TO PIN 5 (INTERAL)
15	
16	
17	
18	SIGNAL LEAD INPUT GND
19	Coax Signal Lead INPUT
20	Ground SIGNAL LEAD INPUT



NOTES:

1. The GFD-5 plugs into the DCS Model GMA-1 Module Assembly. All power and signal connections are made from GMA-1 to GFD-5 via Elco connectors as tabulated.
2. The GFD-5 contains a compartment to accept the plug-in frequency unit Model GFD-5/TU (not a part of GFD-5).
3. Pin connections are numbered from top to bottom.

CO-010155 C

DATA CONTROL SYSTEMS, INC.

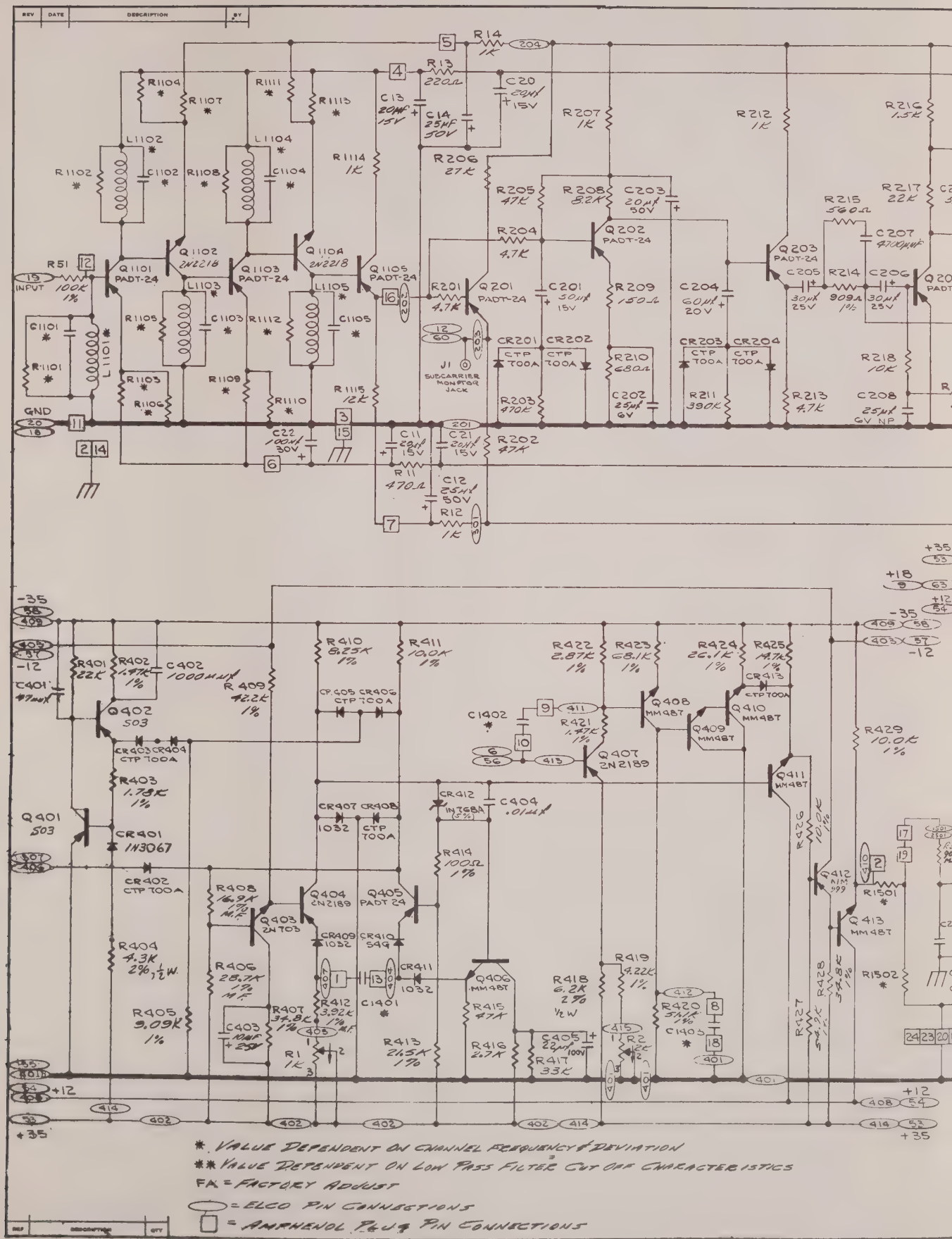
TITLE: OUTLINE GFD-5

TOLERANCES: UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0° 30'
FLATNESS WITHIN /IN.
FRACTIONAL ± 1/32 ± 1/64
NOTE: BREAK ALL SHARP CORNERS .005" - .015" SURFACE ROUGHNESS NOT TO EXCEED

		DATE
DWN	RAT	12-14-62
CHKD	RNG	12/14/62
ENG.	VL	12/14/62
APP.		12/14/62
SCALE	HALF	

DO NOT SCALE DRAWING
MAT'L
FINISH
CO-010155 REV. C
SHEET

GFD-5 | NEXT ASSEMBLY | QTY. /Assy.
PRODUCT



* VALUE DEPENDENT ON CHANNEL FREQUENCY & DEVIATION

** VALUE DEPENDENT ON LOW PASS FILTER CUT OFF CHARACTERISTICS

FA = FACTORY ADJUST

⬭ = ELCO PIN CONNECTIONS

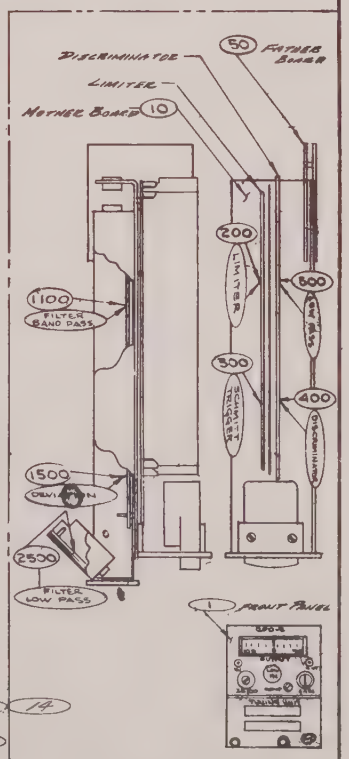
▯ = AMPHENOL PC-J-4 PIN CONNECTIONS

DW-010696 REV. U

REV.	DATE	DESCRIPTION	CH'K APP
01	~	CA 1603 - SEE DWG DW-0102 (5 FOR (50MA)	
02	7/24/63	CA-1638 PIN CONNECTION CHANGE.	
D	2/28/64	CA-1799-1 - COMPONENT CHG'S PER CA	
E	3/24/64	CA-2200 - CR412 WAS IN768	
F	3/11/64	CA-1782-1 - R4 WAS 909-Ω	
G	5/1/64	CA-2332 - Q412 WAS 2N853	
H	6-1-64	CA-2412 Q301 & Q303 TO 2N2501, C-20 TO C-22	
J	7/9/64	CA-2456 - R302 WAS 4.7K	
K	8/5/64	CA-2530 - C405 WAS 22μf 50V	
L	9/9/64	CA-2522 - CHG'D SYMBOL, ?	
M	9/15/64	CA-2609 - R427 WAS 5.6K, 1%	
N	11/2/64	CA-2621 - R519 WAS 330-Ω	
P	2/15/65	CA-2688 - Q102 Q104 WERE 2369	
R	3/9/65	CA-2729 - R404 & R418 CHG'D	
S	4/6/65	CA-2794 - CHG'D Q901, CR901	
T	5/9/65	CA-1307-2 - PIN CONNECTION ADJ.	
U	7/9/65	CA-2794-1 - Q402 WAS PADT-24	

R55 56Ω -35 (5)
L52 1 MH
L53 120 mh
R54 56Ω
C54 25μf 50V -12
C53 8μf 15V
R306 5.6K
R305 2.2K
R315 12K
R307 5.6K
C210 20μf 50V
R23 470Ω
CR301 CTP700A
CR302 CTP700A
Q205 PADT-24
Q301 2N2501
Q303 2N2501
C301 10μf 20V
R312 27K
C303 22μμf
CR306 CTP700A -18 (10) (62)
307 405
C304 10μμf
CR305 CTP700A
Q304 PADT-24
R221 1K 1%
R222 1K 1%
R223 1K 1%
R224 1.47K 1%
R220 511K 1%
CR205 S4G
CR206 S4G
C15 8μf 15V
CR11 CTP700A
R17 2.49K
DS-1
R304 2.7K
Q302 PADT-24
R303 2.2K
R15 11.5K 1%
Q11 2N2189
CR13 CTP700A
C16 .1μf
R308 12K
R309 120K
R302 47K
C303 10μμf
CR304 CTP700A
R311 47K
R313 47K
R310 3.3K
C302 .01μf
R314 1.5K
GND 304 (55) (5)
R225 17.8K 1%
C51 25μf 50V
C52 8μf 15V
L54 1MH
+12 (54) (4)
R52 56Ω
R53 56Ω
301 53 +35 (3)
L51 120μh
414 +35 (53)

507 54 +12
C17 8μf 15V
R503 100K 1%
R504 1M 1%
R513 10K
R514 470Ω
R520 47Ω
R2504 66.5K 1% M.F.
2504 1504
R512 22K
Q506 MM487
R25 1% F.A.
C2503 **
Q503 SM1103CA
C504 22μμf
CR501 1N766-1
Q507 MM487
C502 100μμf
Q504 SM1103CA
Q505 MM487
R519 470Ω
OUTPUT MONITOR JACK J2
OUTPUT 1 (51)
R502 12K
R510 470Ω
CR502 S4G
CR503 700A
R516 2.7K
R517 2.7K
C501 47μμf
Q502 *** SM1103CA OR 2N929
Q501 *** SM1103CA OR 2N929
R2503 100K 1% M.F.
R501 10K 1% M.F.
2505 1505 22 508
C503 .01μf
R506 F.A. 1% M.F.
R507 F.A. 1% M.F.
R521 20K
R505 F.A. 1%
R508 10M
R509 100K 1%
C505 47μμf
R511 22K
506
R522 100Ω
Q508 2N1131
C506 .68Ω
R515 3.9K
R518 47Ω
R22 2.7K
R5 10K
C19 100 MMF
R21 287Ω 1%
R20 76.8Ω 1%
R24 5.6K
Q12 SM1103CA OR 2N929
CR12 CTP 2344
R4 1.05K 1%
R3 309Ω 1%
M1
OUT GND 3 (52) (5) (13) (14)
GND -12 509 57
R19 1K
C18 82μf 15V
555 503
-12 (57) (62) (502) -18 (10)
-18 (62) (502) -12 (57)
58 (504) -35
-35 (58) (504)



DATA CONTROL SYSTEMS, INC.

TITLE SCHEMATIC GFD-5. (STYLE B)

TOLERANCES: UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN .1 IN.
FRACTIONAL HOLES +0.+ 1/64
NOTE: BREAK ALL SHARP CORNERS .005"-.015"

DWN. DATE 3/6/64
CHK'D 3/16/64
PROJ. ENG. DJR 9/5/62
CH. ENG.
SCALE

DO NOT SCALE DRAWING
MAT'L
FINISH

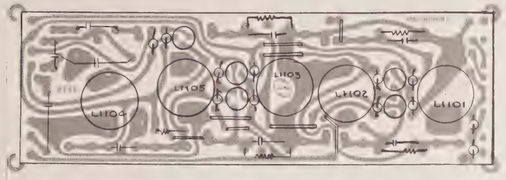
DW-010696 REV U

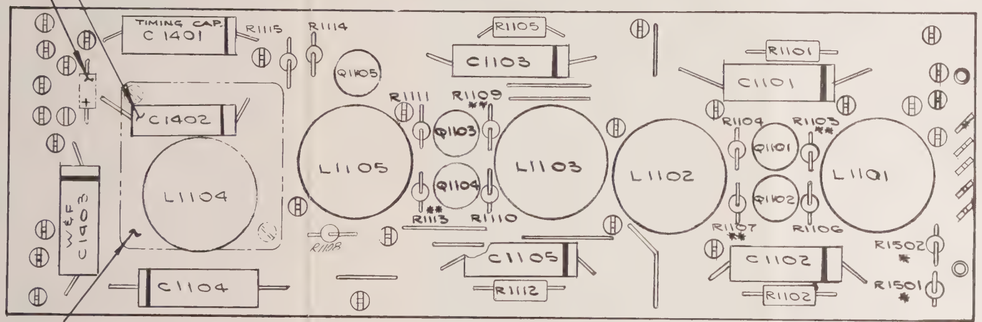
GFD-5 PRODUCT ~ NEXT ASSEMBLY ~ QTY ASSY.

REV	DATE	DESCRIPTION	BY	CHK	APP
01	6/62	CA-1222 CHG Q1102 & Q1104 FAIRCHILD S-3085	WK	M	M
02	7/62	CA-1239 - PICTORIAL CHANGE ON R1501	WK	M	M
03	8/62	CA-1228-1 - CHG'D FAIRCHILD TO S-3085	WK	DAT	M
04	9/62	CA-1762 - ADDED MARKINGS FOR PULL ON CAPS	WK	M	M
5	5/64	CA-1991 - REMOVED JUMPER BETWEEN C1101 & C1102	WK	M	M
6	7/64	CA-2307-2 - CHG'D RESISTOR VALUES	WK	M	M

C1902 W&F IS USED WHEN LARGE COIL IS USED FOR L1104

C1902 W&F IS USED WHEN SMALL COIL IS USED FOR L1104





LARGE FOR CORE

TYP. VIEW OF STAND UP COMPONENT

35	C1908	SEE B/M	CAP.	1

ITEM	SYMBOL	DWG NO.	DESCRIPTION	Q'TY
1		CF-000648	BOARD, BAND PASS	1
2	L1101	SEE B/M		1
3	L1102			1
4	L1103			1
5	L1104			1
6	L1105	SEE B/M		1
7	Q1101		TRANSISTOR, AMPEREX PADT-24	1
8	Q1103		TRANSISTOR, AMPEREX PADT-24	1
9	Q1105		TRANSISTOR, AMPEREX PADT-24	1
10	Q1102		TRANSISTOR, 2N2218	1
11	Q1104		TRANSISTOR, 2N2218	1
12	R1103	**	RES, CEMENTED, 5W, 1% 1.45K	1
13	R1109	** CONSTANT VALUE ON ALL BANDS	RES, 11.5K	1
14	R1107	**	RES, 17.8K	1
15	R1113	**	RES, CG 1/4W, 1% 7.80K	1
16	R1101	SEE B/M	RES,	1
17	R1102		RES,	1
18	R1105		RES,	1
19	R1108		RES,	1
20	R1112	SEE B/M	RES, CG 1/4, 1/4W, 1%	1
21	R1114	* CONSTANT VALUE ON ALL BANDS	RES AB, EB, 1/2W, 1K	1
22	R1115	*	RES, AB, EB, 1/2W, 12K	1
23	R1106	SEE B/M	RES, CG 1/4, 1/4W, 1%	1
24	R1104		RES,	1
25	R1110		RES,	1
26	R1111	SEE B/M	RES, CG 1/4, 1/4W, 1%	1
27	R1501	SEE B/M	RES,	1
28	R1502	SEE B/M	RES	1
29	C1101		CAP.	1
30	C1102		CAP.	1
31	C1103		CAP.	1
32	C1104		CAP.	1
33	C1105		CAP.	1
34	C1902	B/M	CAP.	1

DATA CONTROL SYSTEMS, INC.

TITLE: BAND PASS ASSY

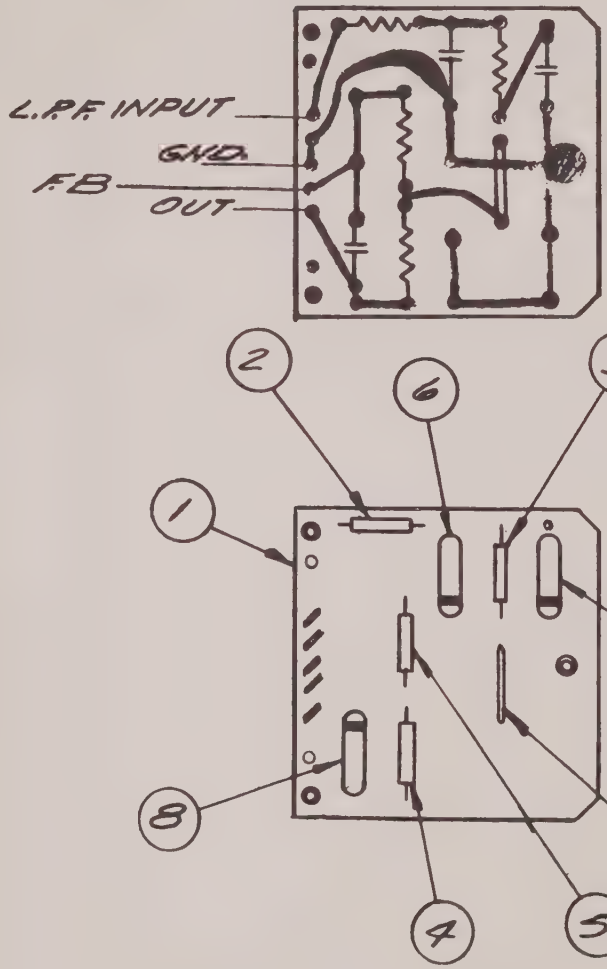
TOLERANCES UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN .001 IN.
FRACTIONAL HOLES -0, + 1/64
NOTE: BREAK ALL SHARP CORNERS .008"-.015"

DRWN DATE 6/62
CHKD
PROJ. ENG.
CH. ENG.
SCALE 2 TO 1

DO NOT SCALE DRAWING
MATL
FINISH

TA-010035 P.V.

GFD-5/TU | CA-010089 | 1



TOLERANCES: UN
OTHERWISE SPECI
DECIMAL - 3 PLACE ±
DECIMAL - 2 PLACE ±
FRAC. ± 1/64 ANG.
FLATNESS WITHIN
FRACTIONAL HOLES -0
NOTE- BREAK ALL SHA
CORNERS .005"
SURFACE ROUGHNESS
TO EXCEED ✓

MAT'L

FINISH

GFU-STU/L CA-010091 1

REF.	DESCRIPTION	QTY.	PRODUCT	NEXT ASSEMBLY	QTY. ASS'Y

BA-009896 01

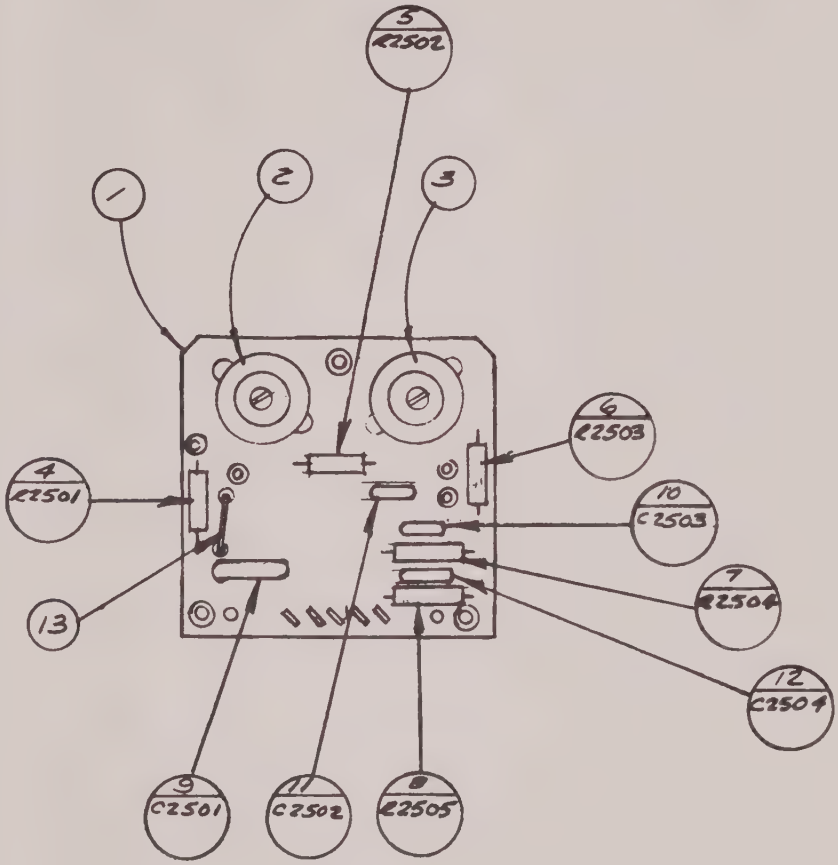
REVISIONS					
SYM.	DESCRIPTION	DATE	BY	CHK'D	APP'D
01	CA-1762-ADDED OUTSIDE FOIL CALLOUT TO CAPS	6-19-63	PRW	RLH	WF

* 4 RES. VALUES ARE THE SAME ON ALL RAUCH LOW PASS CA & LP

	ITEM	SYMBOL	PART NO.	DESCRIPTION	QTY. REQ'D
	8	C2503		CAP. SEE B/M BT-010038	1
	7	C2502		CAP. BT-010038	1
	6	C2501		CAP. BT-010038	1
*	5	R2504		RES. WARD LEONARD WL60-T2 66.5K	1
*	4	R2503		RES. 100K	1
*	3	R2502		RES. 100K	1
*	2	R2501		RES. 90.9K	1
	1		BF-009630	BOARD, LOW PASS FAB	1

DWN. P.J.H	DATE 6/27/62	DATA-CONTROL SYSTEMS, INC. DANBURY, CONN.
CHK'D.	6/27/62	
PROJ. ENG.	6/27/62	TITLE CARD ASSY-LOW PASS FILTER RAUCH
APP'D.	6/27/62	
APP'D.		

CODE IDENT. NO.	SIZE		REV.
	B	BA-009896	01
SCALE FULL		SHEET	



TOLERANCES: UNLESS OTHERWISE SPECIFIED

DECIMAL - 3 PLACE ± .0

DECIMAL - 2 PLACE ± .0

FRAC. ± 1/64 ANG. ± 0°

FLATNESS WITHIN

FRACTIONAL HOLES -0. ±

NOTE- BREAK ALL SHARP CORNERS .005" - .01

SURFACE ROUGHNESS NOT TO EXCEED

MAT'L

FINISH

REF.	DESCRIPTION	QTY.	PRODUCT	NEXT ASSEMBLY	QTY. ASS'Y
			GFD-5/TU/L	BA-010091	1

BA-010105 REV. 01

REVISIONS					
SYM.	DESCRIPTION	DATE	BY	CHK'D	APP'D
01	CA-1821-1 - CHANGED PICTURE PER C.A.	7-1663	DLB	[illegible]	[illegible]

ITEM	SYMBOL	PART NO.	DESCRIPTION	QTY. REQ'D
13			JUMPER #22 BUSS WIRE	1
12	C2504		CAP. SEE FREQ. SENS. SHEET OF B/M	1
11	C2503		CAP. SEE FREQ. SENS SHEET OF B/M	1
10	C2502		CAP. B/M	1
9	C2501		CAP, SEE FREQ. SENS SHEET OF B/M	1
8	R2505		RES, B/M	1
7	R2504		RES, B/M	1
6	R2503		RES, B/M	1
5	R2502		RES, B/M	1
4	R2501		RES, SEE FREQ. SENS SHEET B/M	1
3	L2502	CA-009562	TOROID ASS'Y	1
2	L2501	CA-009562	TOROID ASS'Y	1
1		BF-010104-02	BOARD FAB, LPF (5POLE RLC)	1

		DATE
DWN.	[illegible]	11/9/62
CHKD.	[illegible]	11/9/62
PROJ. ENG.	[illegible]	11/9/62
APP'D.	[illegible]	11/9/62
APP'D.		

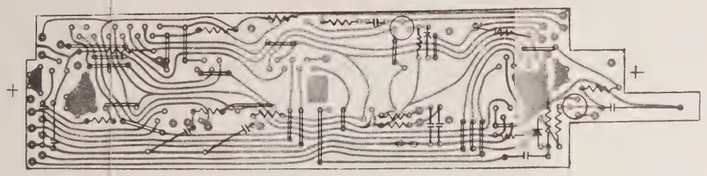
DATA-CONTROL SYSTEMS, INC.
DANBURY, CONN.

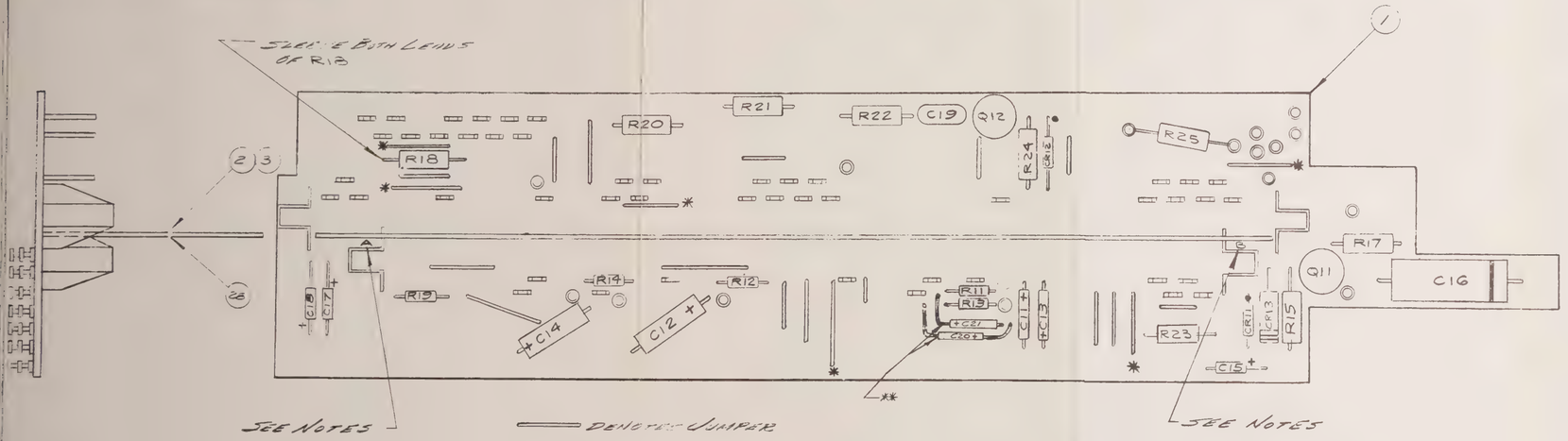
TITLE: CARD ASS'Y, LPF (5POLE RLC)

CODE IDENT. NO.	SIZE		REV.
	B	BA-010105	01

SCALE FULL SHEET 1 OF 1

REV.	DATE	DESCRIPTION	BY	ENG CHK	ENG APPR
C1	9/12	ADDED R23, R24, R25 & T12, T13 R&E	C		
02	9/19	CA-1206 CHG'D QTY. INST. OF R17, R19, R20, R21, R15 & T12, T13 R&E	DK		
03	10/4	CA-1283 - R11 & R12 MADE 1/4 W	DK		
04	10/6	CA-1303 - ADD'D C20 & C21, NOTE	RWO	RT	
05	10/6	CA-1387 - ADDED DIODE TO Q12	DK		
06	10/3	CA-1586 - DELETED ITEM 28	DK		
07	11/3	CA-1675 - CHG'D PICTORIAL VIEW	DK		
08	11/9	CA-1762 - ADDED FOIL CAP	DK		
09	11/10	CA-1799 - ADDED CR13 & LETTERING	DK		
10	12/28	CA-2126 - ADDED T1, 115K	DK		





ITEM	SYMBOL	DWG NO	DESCRIPTION	QTY
32	R24		RES, AB, CB, 1/4W 10%, 5.6K	1
33	R25		RES, CC, 1/4W, 1% TEXAS INST. F.A	1
34	R23		RES, AB, CB, 1/4 W, 470Ω	1
* 35			SLEEVING, TEFLON #22	4"
	C20		CAP, GE "62F202, 15V 20MF	1
	C21		CAP, GE "62F202, 15V 20MF	1

NOTES:
1. INSTALL ITEMS 4 THRU 26 THEN DIP SOLDER
2. SOLDER ITEM 2 TO ITEM 1 AT ELCO GUIDES AT A & B
3. INSTALL ITEMS 3 TO ITEM 2 WITH ADHESIVE

ITEM	SYMBOL	DWG NO	DESCRIPTION	Q'TY
1		CF-009898	FAB, MOTHER BD.	1
2		BD-009899	SHIELD	1
3		BD-009899	INSULATOR, SHIELD	2
4	R11		RES-AB, CB, 1/4W, 5% 470Ω	1
5	R13		330Ω	1
6	R12		1K	1
7	R14		1K	1
8	R18		1K	1
9	R19		1K	1
10	R15		RES, [illegible] MF50 [illegible] 1/4 W 4.5K	1
11	CR13		DIODE, CLEVITE CTP700A	1
12	R17		RES, [illegible] 1/4 W 1% 3.83K	1
13	R22		RES, [illegible] 2.7K	1
14	R20		RES, TI [illegible] 1/4W, 1% 12.1K	1
15	R21		1.28K	1
16	C11		CAP GE "62F202 15V 20MF	1
17	C13		15V 20MF	1
18	C12		CAP GE "62F305 50V 5MF	1
19	C14		50V 5MF	1
20	C15		CAP GE "62F102, 15V 1MF	1
21	C17		15V 8MF	1
22	C18		15V 8MF	1
23	C16		CAP AEROVOX VBRB 150V .1MFD	1
24	C19		CAP SYRMIKA DM-10 100V 100 100MMF	1
25	CR11		DIODE, CLEVITE CTP700A	1
26	Q11		TRANSISTOR, TEXAS INST. 2N2137	1
27			ADHESIVE, ARCHITECT #111	3/4"
28				
29			TRANSIPAD, MILTON ROSS A100038	1
30	Q12		TRANSISTOR, 2N [illegible] OR CTP [illegible]	1
31	CR12		DIODE, CLEVITE CTP [illegible]	1

REQ'D	NEXT ASSEMBLY	QTY.
QFD-5	DA-010050	1

DATA CONTROL SYSTEMS, INC.

TITLE: CARD MOTHER ASS'Y

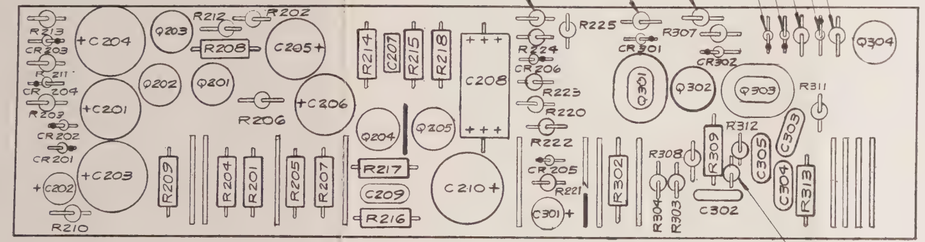
TOLERANCES: UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN .003" IN.
FRACTIONAL HOLES -0, + 1/64
NOTE: BREAK ALL SHARP CORNERS .005"-.015"

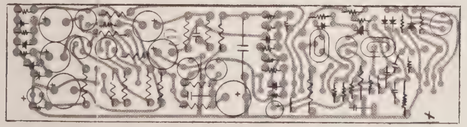
		DATE
DWN	P.M	8/19/62
CHKD	DK	9/6/62
PROJ. ENG	W	11/9/62
CH ENG	W	5/18/63
SCALE	2X	

DO NOT SCALE DRAWING
MATL
FINISH
QTY 1

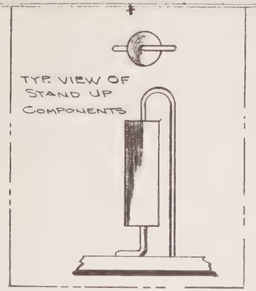
TA-010036

REV	DATE	DESCRIPTION	BY CHK	APP'D	BY
01	7/16/62	CA-1078. C203, C283, C303, C308 & C305 WERE 150V.	RW	W	VRG
02	9/6/62	CA-1184 REVISED PER ECO #311 C302. SEE VALUES, R215 WAS 180Ω, R302 WAS 6.8K, R203 WAS 68Ω, R303 WAS 10K CA 12.10 ITEM 72, C207 WAS BURNICA 100V, 10%		W	W
03	12-18-62	CA-1395. CHG'D C302 PER CA	VRG	RWA	W
E	3-5-63	CA-2261-0301 & 0303 WORK ORDER	RWA	W	W
F	9/18/63	CA-2352-COMPONENT CHGES.	RWA	W	W
G	3/24/64	CA-2456-ECM2 WAS 4.7K	RWA	W	W
H	7/28/65	CA-2845-ADDED NOTE 1	RWA	W	W





TYP VIEW OF STAND UP COMPONENTS



• DENOTES CATHODE

— DENOTES JUMPER

NOTE:
CR205 & CR206 MAY ALSO BE REPLACED WITH DIODE 2B42 (G.E.)

70	C301		CAP, TEL TYPE 1405	20K/10MF	1	35	R213		RES, AB EB, 1/2W, 10%	4.7K	1	ITEM	SYMBOL	DWG. NO.	DESCRIPTION	Q'TY
71						36	R216			1.5K	1	1		CF-009684	BOARD, LIMITER	1
72	C207		CAP VITRAMON VK20CW472M	4700 MMF	1	37	R217			22K	1	2	Q201		TRANSISTOR AMPEREX 2N404 DT-29	1
73	C209		BURNICA DM15 500V, 10%	5 MMF	1	38	R218			10K	1	3	Q202			1
74	C303			10 MMF	1	39	R219			2.2K	1	4	Q203			1
75	C304			10 MMF	1	40						5	Q204			1
76	C305		BURNICA DM15 100V, 10%	22 MMF	1	41	R302		RES, AB CB, 1/4W, 10%	47K	1	6	Q205			1
77	C308		CAP, ELMENCO TYPE 20MF 350V ELCO	25 MF	1	42	R303		RES, AB EB, 1/2W, 10%	2.2K	1	7	Q302			1
78	C302		CAP, MICRO SEAL (STYLE) 11901	0.1 MF	1	43	R304			2.7K	1	8	Q304			1
79			TRANSPAD MILTON ROY A10126		11	44	R305			2.2K	1	9	Q301		TRANSISTOR, 2N2501	1
						45	R306			56K	1	10	Q303			1
						46	R307			3.6K	1	11	CR201		DIODE, GERMANIUM GTP 700A	1
						47	R308			12K	1	12	CR202			1
						48	R309			120K	1	13	CR203			1
						49	R310			3.3K	1	14	CR204			1
						50	R311			47K	1	15	CR301			1
						51	R312			27K	1	16	CR302			1
						52	R313		RES, AB, CB, 1/4W, 10%	47K	1	17				
						53	R314		RES, AB EB, 1/2W, 10%	4.5K	1	18	CR304			1
						54	R315			12K	1	19	CR305			1
						55	R215		TEXAS INST.	560Ω	1	20	CR306			1
						56	R214		RES, CB, 1/4W, 1%	909Ω	1	21	CR205		DIODE, TRANSITRON 3026	1
						57	R220			511K	1	22	CR206			1
						58	R221			1K	1	23	R201		RES, AB, E.B, 1/2W, 10% 4.7K	1
						59	R222			1K	1	24	R202		47K	1
						60	R223			1K	1	25	R203		470K	1
						61	R224			1.47K	1	26	R204		RES, AB CB 1/4W, 10% 4.7K	1
						62	R225			17.8K	1	27	R205		RES, AB, EB, 1/2W, 10% 47K	1
						63	C201		CAPACI TYPE 1405	1545MF	1	28	R206		27K	1
						64	C202			6V, 25MF	1	29	R207		RES, AB CB 1/4W, 10% 1K	1
						65	C203			30K, 20MF	1	30	R208		RES, AB, EB, 1/2W, 10% 3.2K	1
						66	C204			20V, 60MF	1	31	R209		150Ω	1
						67	C205			25V, 30MF	1	32	R210		680Ω	1
						68	C206			25V, 30MF	1	33	R211		390K	1
						69	C210			30V, 20MF	1	34	R212		1K	1

GFD-5 | DA-010090 | 1

DATA CONTROL SYSTEMS, INC.

TITLE: CARD, LIMITER ASSY

TOLERANCES - UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN .002"/IN.
FRACTIONAL HOLES - Ø, 4-1/64
NOTE: BREAK ALL SHARP CORNERS .005" - .015"

	NAME	DATE
DWN	PJH	9/16/62
CHKD		
PROJ ENG		
CH ENG		
SCALE		

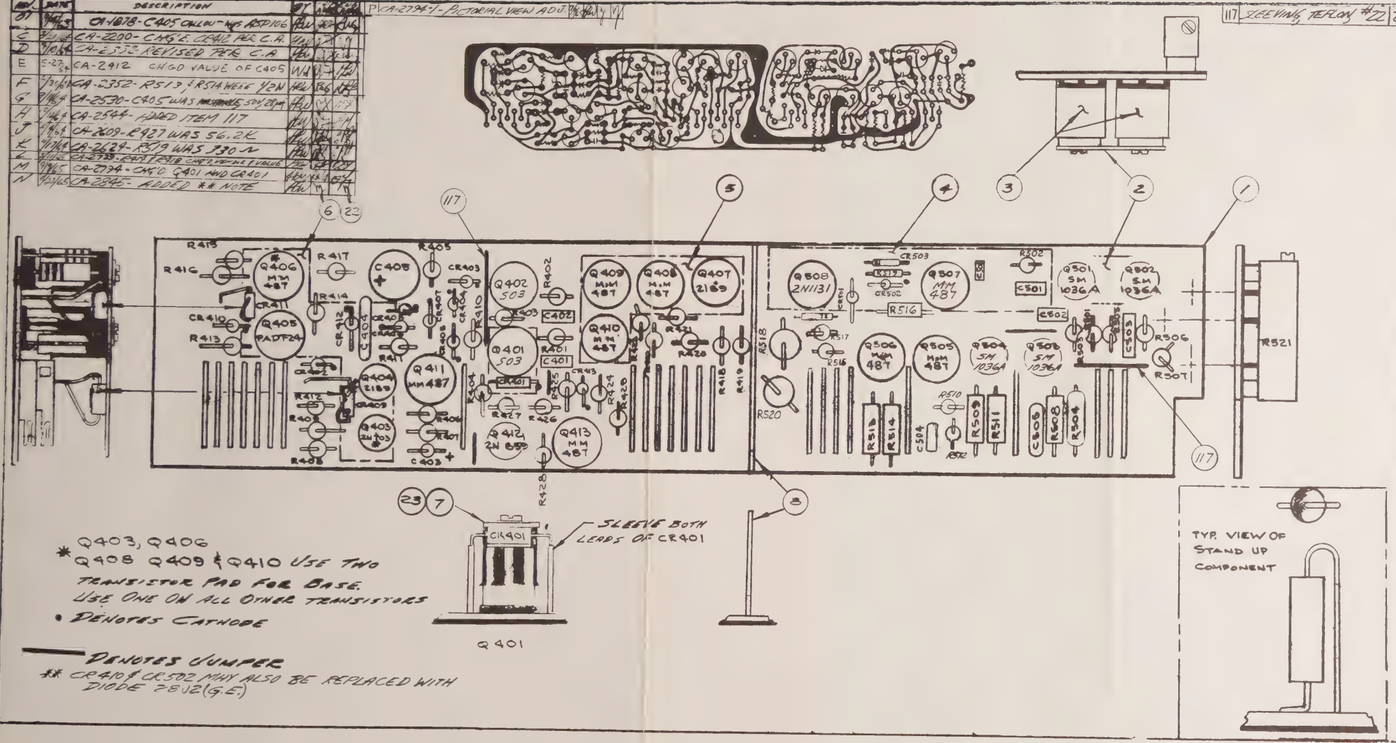
DO NOT SCALE DRAWING
MAT'L
FINISH

DA-010052 | REV H

LTR	QTY	DESCRIPTION	ITEM	DWG NO
C		CA-1078-C405 CHG "MC" ASSY/16	REF	
D		CA-2200-C405 CHGD PER C.A.	REF	
E		CA-2313 REVISED PER C.A.	REF	
	C-27	CA-2412 CHGD VALUE OF C405	REF	
F		CA-2352-R513, R514 & R516 WERE V2N	REF	
G		CA-2530-C405 WAS 4000 MFD, 50V DM	REF	
H		CA-2544-ADDED ITEM 117	REF	
J		CH-209-E937 WAS 56.2K	REF	
K		CA-2629-R519 WAS 330Ω	REF	
L		CA-2538-CHGD PARTS LIST & SCHEMATIC VALUE	REF	
M		CA-2734-CHG'D Q401 AND CR401	REF	
N		CA-2842-ADDED ** NOTE	REF	

PVA-2794-1-PICTORIAL VIEW ADDED

117 SLEEVING TEFLON #22 2



Q403, Q406
* Q408 Q409 & Q410 USE TWO TRANSISTOR PAD FOR BASE. USE ONE ON ALL OTHER TRANSISTORS
• DENOTES CATHODE

DENOTES JUMPER
** CR401 & CR502 MAY ALSO BE REPLACED WITH DIODE 2B12(G.E.)

Q401

SLEEVE BOTH LEADS OF CR401

TYP. VIEW OF STAND UP COMPONENT

75	Q501		TRANSISTOR, 2N1132 OR SM1036A		1
76	Q502		TRANSISTOR, 2N1132 OR SM1036A		1
77	Q503		TRANSISTOR		1
78	Q504		TRANSISTOR		1
79	Q505		TRANSISTOR, MM487		1
80	Q506				1
81	Q507				1
82	Q508		TRANSISTOR, 2N1131		1
83	CR501		DIODE, IN TRANSITRON TG-71		1
84	C501		CAP, VITRAMON 500V 5% 47MMF		1
85	C502		VK20CW101M, 100MMF		1
86	C503		VK20CW103M, .01MF		1
87	C504		CAP, DURMICA, 100V, 1% DM20		1
88	C506		CAP, 2@ VK20CW682M 6800 MMF		1
89	C505		CAP, DURMICA, DM20, 100V, 5%	47MMF	1
90	R501		RES, WARD LEONARD WL-GOTZ 1%	10K	1
91	R506		RES,	1MEG	1
92	R507		RES, WARD LEONARD WL-GOTZ, 1%	ABOUT	1
93	R508		RES, TEXAS INST. CB, 1/2W, 1%	100K	1
94	R504		RES,	1MEG	1
95	R505		RES,	R.A.	1
96	R509		RES, TEXAS INST. CB, 1/4W, 1%	100K	1
97	R518		RES, MEPCO PI, 1%	47Ω	1
98	R520		RES, MEPCO PI, 1%	47Ω	1
99	R521		RES, BOURNS ES TRIM #3009P-1-203	20K	1
100	R508		RES, AB EB, 1/2W, 10%	10 MEG	1
101					
102					
103	R511		RES,	22K	1
104					
105	R513		RES, MK CB 1/4W, 10%	10Ω	1
106	R514		RES, MK CB 1/4W, 10%	470Ω	1
107	R515		RES, MK CB 1/4W, 10%	3.9K	1
108	R516		RES,	2.7Ω	1
109	R517		RES,	2.7Ω	1
110	R519		RES, AB, EB, 1/4W, 10%	470Ω	1
111	R502			12K	1
112	R510			470Ω	1
113	R512			82K	1
114	R522			100Ω	1
115	CR502	**	DIODE, TRANSITRON 1N48		1
116	CR503		DIODE, CLEVITE, CTP7004		1
117	CR401	**	DIODE, TRANSITRON 1N48		1
118	CR504		DIODE, CLEVITE, CTP7004		1
119	CR505		DIODE, CLEVITE, CTP7004		1
120	CR506		DIODE, CLEVITE, CTP7004		1
121	CR507		DIODE, CLEVITE, CTP7004		1
122	CR508		DIODE, CLEVITE, CTP7004		1
123					
124					
125					
126					
127					
128					
129					
130					
131	CR407		DIODE, CLEVITE CHP-1032		1
132	CR409		DIODE, CLEVITE CHP-1032		1
133	CR412		DIODE, SEMICONDUCTOR INC. IN456A		1
134	C401		CAP, VK20CW682M, 6800MMF		1
135	C402		CAP, VK20CW103M, .01MF		1
136	C403		CAP, GLE 1000 MFD, 10V		1
137	C404		CAP, MUCON STABLER 1000 MFD, 10V		1
138	C405		CAP, SPRAGUE TRANSISTOR 1000 MFD, 10V		1
139	R402		RES, TEXAS INST. CB, 1/4W, 1%	1.47K	1
140	R403			1.78K	1
141	R404		RES, CORNING CEA-20, 1/4W, 2%	2.43K	1
142	R405		RES, TI, CB, 1/4W, 1%	9.09K	1
143	R407			34.8K	1
144	R409			42.2K	1
145	R410			8.25K	1
146	R411			10.0K	1
147	R413			2.5K	1
148	R414			100Ω	1
149	R418		RES, TI, CB, 1/4W, 1%	6.2K	1
150	R419		RES, TI, CB, 1/4W, 1%	4.22K	1
151	R420			5.1K	1
152	R421			1.47K	1
153	R422			12.87K	1
154	R423			68.1K	1
155	R424			26.1K	1
156	R425			1.47K	1
157	R429		RES, TEXAS INST. CB, 1/4W, 1%	10.0K	1
158	R406		RES, WARD LEONARD WL-GOTZ 1%	28.7K	1
159	R408		RES,	16.9K	1
160	R412		RES, WARD LEONARD WL-GOTZ 1%	3.92K	1
161	R426		RES, TEXAS INST. CB, 1/4W, 1%	10.0K	1
162	R427		RES, TEXAS INST. CB, 1/4W, 1%	5.49K	1
163	R401		RES, AB EB, 1/2W, 10%	22K	1
164	R415		RES,	47K	1
165	R416		RES,	2.7K	1
166	R417		RES, AB EB, 1/2W, 10%	33K	1
167	Q413		TRANSISTOR, MOTOROLA MM487		1
168	R428		RES, TEXAS INST. CB, 1/4W, 1%	34.8K	1
169					
170					
171					
172					

ITEM	SYMBOL	DWG NO	DESCRIPTION	QTY
1		CP-010698	BOARD, DISCRIMINATOR	1
2		BD-009816	M EQUALIZER	1
3		BD-010112	INDUCTOR, TRANSISTOR	2
4		BD-009705	HEAT SINK	1
5		BD-010027	HEAT EQUALIZER L/F	1
6		BD-010028	HEAT EQUALIZER #1	1
7		BD-010030	HEAT EQUALIZER #2	1
8		BD-009901	SHIELD	1
9	Q401		TRANSISTOR, TI 503	1
10	Q402		TRANSISTOR	1
11	Q405		TRANSISTOR, AMPEREX PADT-24	1
12	Q406		TRANSISTOR, MOTOROLA MM 487	1
13	Q408			1
14	Q409			1
15	Q410			1
16	Q411		TRANSISTOR, MOTOROLA MM487	1
17	Q412		TRANSISTOR, MM 499	1
18	Q403		TRANSISTOR, TEXAS INST. 2N 703	1
19	Q404		TRANSISTOR, TEXAS INST. 2N 2169	1
20	Q407		TRANSISTOR, TEXAS INST. 2N 2169	1
21	CR401		DIODE, CONT. DEVICE 1N2967	1
22		BD-010029	CLIP, #1	2
23		BD-010030	CLIP, #2	1
24	CR402		DIODE, CLEVITE CTP 7004	1
25	CR403			1
26	CR404			1
27	CR405			1
28	CR406			1
29	CR408			1
30				
31	CR413		DIODE, CLEVITE CTP 7004	1
32	CR410	**	DIODE, TRANSITRON 1N48	1
33	CR411		DIODE, CLEVITE CHP-1032	1

DATA CONTROL SYSTEMS, INC.

TYPE BASIC CARD ASSY STYLE B

DO NOT SCALE DRAWING

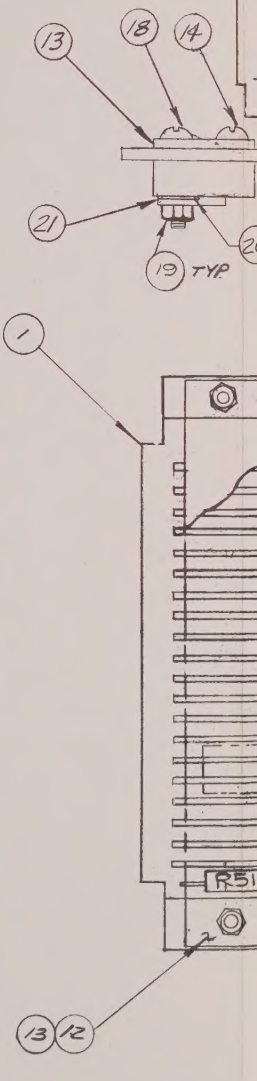
DWN 2-14-67 MATL

CHK'D PRO ENG CH ENG

SCALE 2:1

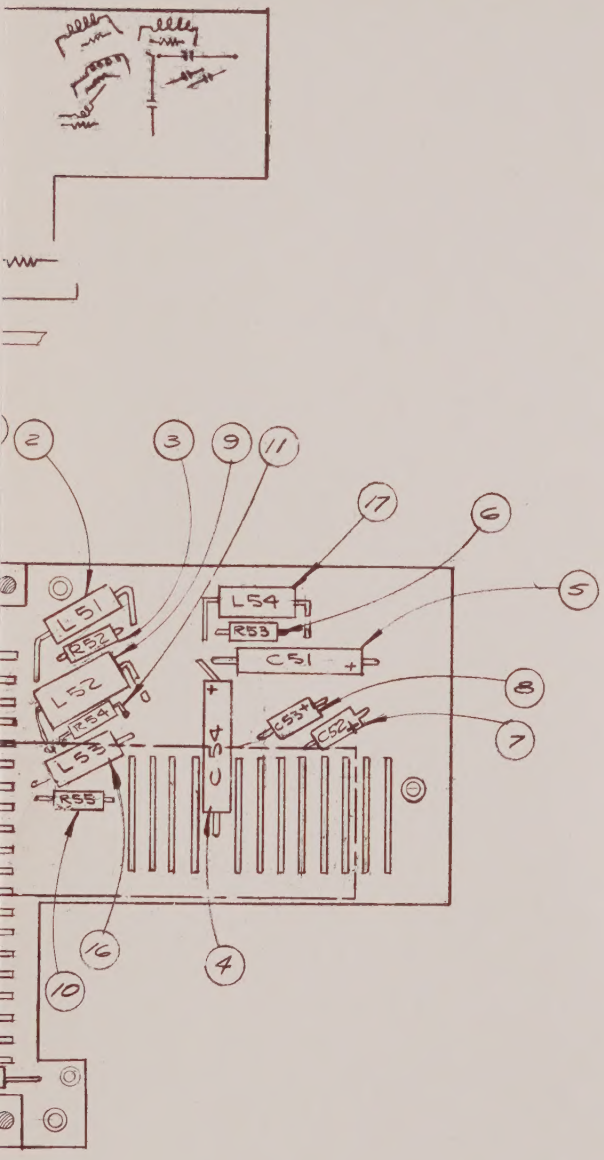
GA-010697

REV.	ZONE	DESCRIPTION	DATE	DWN.	CHK.	APP.
01	—	CA-1277-ADDED VALUE TO L52.	10-27-62	DPW	RAT	
02	~	CA-1903 REDESIGN BOARD TO ADD L53 & L54	4/1/63	VK	RAT	
03	~	CA-1530-REVERSED C52 POLARITY	6-27-63	DRW	RAT	
04	~	CA-1683-ADDED ITEM 21	9-3-63	DRW	RAT	RWG
05	~	CA-1683-1 - ITEM 18 HAS 1/2 LG.	5-3-62	DRW	RAT	RWG
06	~	CA-1683-2-RELOCATED ITEM 21	6-17-63	DRW	RAT	RWG
H	~	CA-2599-ADDED ITEM 20 TO VIEW	4/5/64	DRW	RWG	



REF.	DESCRIPTION	QTY

ITEM	SYMBOL	DWG. NO.	DESCRIPTION	
1		BF-010106	BOARD, FATHER	1
2	L51		CHOKE, NYTRONICS INC. WEE-DUCTOR, WEE 120	1
3	R52		RES, AB, CB 1/4W, 10%, 56Ω	1
4	C54		CAP. G.E. G2F 305, 50V, 25μF	1
5	C51		CAP. G.E. G2F 305, 50V, 25μF	1
6	R53		RES, AB, CB 1/4W, 10% 56Ω	1
7	C52		CAP. G.E. G2F102, 15V, .8μF	1
8	C53		CAP. G.E. G2F102, 15V, .8μF	1
9	L52		CHOKE, DELEVAN INC. RING DING #2500-2, 1MH.	1
10	R55		RES, AB, CB 1/4W, 10%, 56Ω	1
11	R54		RES AB, CB 1/4W, 10%, 56Ω	1
12		BD-008927	BLOCK GUIDE	2
13		BD-009835	WASHER, PLATE	2
14			SCREW, #4-40NC-2A X 5/16 LG RHMS ST'L CAD PL	2
15	R51		RES, TEXAS INST. CG1a, 1/4W, 1% 100K	1
16	L53		CHOKE, NYTRONIC INC. WEE-DUCTOR, WEE 120	1
17	L54		CHOKE, DELEVAN INC. RING DING #2500-2, 1MH	1
18			SCREW, 4-40NC-2A X 1/2 LG, RHMS, ST'L CD. PL.	2
19			LOCKNUT, #92-1660-40	2
20			FLATWASHER, #4, 1/4 O.D., .030THK X 1/8 I.D.	2
21		BF-010996	SHIELD, FATHER	1



CA-010118 REV. H

GFD-5	DA-010090	1
PRODUCT	NEXT ASSEMBLY	QTY. /ASSY.

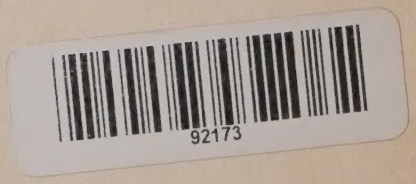
DATA CONTROL SYSTEMS, INC.

TITLE: CARD, FATHER ASS'Y

TOLERANCES: UNLESS OTHERWISE SPECIFIED
DECIMAL - 3 PLACE ± .005
DECIMAL - 2 PLACE ± .010
FRAC. ± 1/64 ANG. ± 0°30'
FLATNESS WITHIN ~/IN.
FRACTIONAL HOLES -0. ± 1/64
NOTE- BREAK ALL SHARP CORNERS .005"-.015" SURFACE ROUGHNESS NOT TO EXCEED ✓

	DATE
DWN.	9/27/67
CHKD.	10/5/67
ENG.	10/11/67
APP.	10/11/67
SCALE	—

DO NOT SCALE DRAWING
MAT'L —
FINISH —
CA-010118 REV. H
SHEET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